# SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 8
APRIL 15, 1970

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# WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

# FOREWORD

**Selected Water Resources Abstracts,** a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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# SELECTED WATER RESOURCES ABSTRACTS

## 02. WATER CYCLE

### 2A. General

**PRECIPITATION AFFECTS INCREASES IN STREAMFLOW AFTER CONVERTING BRUSH TO GRASS IN ARIZONA,**
Agricultural Research Service, Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-02882

**INVENTORY OF SPRINGS IN THE MOREY PEAK AREA OF CENTRAL NEVADA,**
Geological Survey, Denver, Colo.
J. D. Larson, and J. E. Weir, Jr.
Geol Surv Open-file Report, Nov 1969. 22 p, 8 fig, 2 tab, 4 ref. AEC Contract AT (29-2)-474.

Descriptors: *Springs, *Discharge (Water), *Nevada, Groundwater, Water resources, Stock water, Domestic water, Water quality, Water temperature, Data collections, Hydrologic data.
Identifiers: Morey Peak (Nevada).

About 90% of springs above 2,134 meters (7,000 feet) altitude in lat 38 deg 30 min-38 deg 45 min N. long 116 deg 15 min-116 deg 27 min W., in central Nevada were inventoried; 10 springs issue from local valley-fill material of Quaternary age and 12 springs from volcanic material of Tertiary age. Springs used for stock or domestic supplies were emphasized during the inventory. Analysis of water samples collected July 22-30, 1968, indicate that hardness ranges from 35 to 506 mg/l and dissolved-solids content ranges from 74 to 584 mg/l. Water discharges and temperatures were measured and ranged from 0.5 to 220 cu m per day, and from 6.5 deg to 25.0 deg C. Analysis of water samples collected Oct 11-14, 1968, indicate that hardness ranges from 23 to 477 mg/l and dissolved-solids content ranges from 108 to 694 mg/l. Water discharges and temperatures were measured and ranged from 0.5 to 65 cu m per day and from 6.0 deg to 16.0 deg C. (Knapp-USGS)
W70-02883

**A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,**
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
P. B. S. Sarma, J. W. Delleur, and A. R. Rao.
Available from the Clearinghouse as PB-189 043, $3.00 in paper copy, $0.65 in microfiche. Purdue University Water Resources Research Center Technical Report No 9. Oct 1969. 240 p, 58 fig. 30 tab, 105 ref, 3 append. OWRR Project B-002-IND.

Descriptors: *Urbanization, *Storm runoff, *Watersheds, Water yield, Runoff, *Rainfall-runoff relationships, Hydrographs, Rainfall, Runoff coefficient, *Time lag, *Model studies, *Simulation.
Identifiers: Nash model, Single linear reservoir model, Double routing, West Lafayette Watershed.

The data for this study were taken from four watersheds with varying degrees of urbanization located in West Lafayette, Indiana. The analytical approach adopted was the linear (time variant, lumped) system analysis. The conceptual linear systems considered in the analysis of the data were the single linear reservoir model, the double routing method, the Nash model, and the single linear-reservoir with linear-channel model. The single linear reservoir model was selected to simulate the rainfall-runoff process on small urban watersheds (less than 5 square miles) based on its superior regeneration performance while the Nash model served best on the larger watersheds (between 5 and 20 square miles). The relationship of the degree of urbanization and the time lag, the magnitude of the peak discharge, and the frequency of peak discharge were studied. Studies will be continued with linear models and, in addition, nonlinear models will be considered in the hydrologic simulation of the larger watersheds in order to develop design methods and criteria for predicting runoff from areas with varying degrees of urbanization.
W70-03035

**A DISPERSION ANALOG MODEL FOR WATERSHED SYSTEMS,**
Technion - Israel Inst. of Tech., Haifa.
M. H. Diskin.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 6, p 38-45, 1967. 8 p, 5 fig, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Hydraulic models, *Analog models, Tracers, Runoff forecasting, Hydrograph analysis, Unit hydrographs, Dispersion, Simulation analysis.
Identifiers: *Rainfall-runoff models, Israel, Watershed models.

A watershed system may be simulated by means of a model consisting of a wide gravel covered channel or tray in which a steady flow of water is maintained. The water enters the channel at a number of points and leaves it at one outlet. The varying times of travel from various parts of the watershed are simulated in the model by imposing on it a velocity field, which is defined by the shape of the tray, by the arrangement of the gravel in the tray and by the arrangement of the points at which the steady inflow of water is introduced. Rainfall is simulated in the above model by injecting concentrated salt solution at the various parts of the watershed model or over its entire surface. Runoff is simulated by the concentration of salt in the water flowing out from the model. The concentration is continuously measured and its variation with time represents the outflow hydrograph. The responses to short duration inputs obtained in the various models tested were all positively skewed distribution in the form typical to instantaneous unit hydrographs from actual watersheds. The form of the impulse response depended on the extent and on the areal distribution of the incoming pulse. Simulation of short duration storms moving upstream or downstream in the model watersheds indicated significant changes in the form of the outflow hydrographs in comparison to a stationary storm of the same duration and rainfall. (Knapp-USGS)
W70-03128

**A SIMULATED WATERSHED FLOW SYSTEM FOR HYDROGRAPH PREDICTION; A KINEMATIC APPLICATION,**
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
D. L. Brakensiek.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 3, p 18-24, 1967. 7 p, 3 fig, 1 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Synthetic hydrology, Unit hydrographs, Runoff forecasting, Simulation analysis, Rainfall disposition, Streamflow forecasting.
Identifiers: Kinematic flow theory.

The upland watershed has generally been treated as a lumped system, that is, one in which graphs are predicted by the unit hydrograph theory or by a routing technique utilizing a reservoir storage analog. An upland watershed may be transformed into a one-dimensional flow system. Simple kinematic flow equations are utilized to route estimated rainfall excess. An example indicates that the computational system is feasible for predicting hydrographs. Hydrologic parameters of the watershed as a function of elevation can be introduced and evaluated as modifiers of the watershed hydrologic performance. (Knapp-USGS)
W70-03129

**USE OF LOG-TRANSFORMATION TO THE ANALYTICAL REPRESENTATION OF RIVER RUNOFF,**
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03130

**RUNOFF ANALYSIS AND WATER-BALANCE ANALYSIS BY A SERIES STORAGE TYPE MODEL,**
National Research Center for Disaster Prevention, Tokyo (Japan).
Masami Sugawara.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 5, p 31-37, 1967. 7 p, 12 fig.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Water storage, *Routing, Hydrograph analysis, Unit hydrographs, Rainfall intensity, Rainfall disposition, Evapotranspiration, Infiltration, Synthetic hydrology.
Identifiers: *Japan.

Storage type models are based on the hypothesis that both discharge and infiltration are functions of the amount of water stored in the ground, and which can be simulated approximately by a vessel having some outlets at the side and an outlet at the bottom. Although it can represent automatically the nonlinear character of the runoff phenomena, the storage model is not very sensitive to the precipitation intensity. The series storage model modifies this defect by using a vertical series of storage-type structures. This model gives good results in runoff analysis of Japanese rivers. Runoff structures of the river basins differ, but rivers in volcanic terraines have uniform large groundwater inflows, and their hydrographs are flat and smooth. The effect of soil moisture need not be considered in Japan where there is no dry season and the soil is nearly always wet. As the soil is always wet, we need not separate the actual evapotranspiration from the potential one. The runoff analysis of snowy basins is possible by dividing them into several zones. Though the series storage-type model gives good results for Japanese rivers, some modification must be necessary for the basins of nonhumid regions or of the regions where there is a half-year dry season. (Knapp-USGS)
W70-03131

**ANALYTICAL SIMULATION OF WATERSHED HYDROGRAPHS FROM RAINFALL,**
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
D. E. Overton.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 2, p 9-17, 1967. 9 p, 2 fig, 20 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Synthetic hydrology, *Runoff forecasting, Simulation analysis, Hydrologic budget, Rainfall disposition, Hydrographs, Unit hydrographs.
Identifiers: Hydrograph simulation.

Upland watershed hydrographs are usually estimated using unit hydrograph techniques. In view of the apparent vagaries of the unit hydrograph from storm to storm and the computational tedium involved in summations, new approaches are presented which may relieve these difficulties. The hydrologic reaction of the watershed is considered as a series of linear reservoirs in one approach and as a group of nonlinear reservoirs acting in parallel in another approach. Bases for estimation of the routing parameters are presented in an attempt to relate them to the physical characteristics of the watershed and the supply rate of the storm. (Knapp-USGS)
W70-03132

**A DISTRIBUTED LINEAR MODEL FOR PEAK CATCHMENT DISCHARGE,**
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
Peter S. Eagleson.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 1, p 1-8, 1967. 8 p, 1 fig, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Routing, *Rainfall disposition, Rainfall intensity, Peak discharge, Linear programming, Synthetic hydrology, Unit hydrographs, Mathematical models.
Identifiers: Kinematic wave theory.

The kinematic wave solution for surface runoff is used to obtain the contribution to peak discharge from an impulse of rainfall excess located at distance x from the catchment outlet. This spatial impulse response is employed in a linearization of the catchment dynamics to obtain a simple superposition relation for estimating the effect of areal variability in rainfall distribution upon the peak surface runoff. (Knapp-USGS)
W70-03133

**A MATHEMATICAL WATERSHED ROUTING MODEL,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. E. Machmeier, and C. L. Larson.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 9, p 64-71, 1967. 8 p, 2 fig, 10 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Streamflow forecasting, *Runoff forecasting, Simulation analysis, Computer models, Rainfall disposition, Rainfall intensity, Unsteady flow.
Identifiers: Watershed routing models.

A mathematical model of a 21.35-sq mi hypothetical watershed was developed. All of the channel characteristics are defined mathematically. Input to the watershed is rainfall excess of any selected rate and duration. The unsteady flow is routed through the channel system by the use of the partial differential equations of momentum and continuity in finite difference form. The watershed can be used to study the effects of supply rate and duration as well as physical characteristics of the watershed that effect the hydrologic process. (Knapp-USGS)
W70-03134

**A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,**
For primary bibliographic entry see Field 07C.
W70-03135

**URBAN STORM DRAINAGE CRITERIA MANUAL.**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

**RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03151

## 2B. Precipitation

**A REVIEW OF PROJECT FOG DROPS,**
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
Roland J. Pilie.
Report available from Clearinghouse for $3.00 in paper copy, $0.65 in microfiche. NASA Special Publication Report SP-212, Proceedings of Symposium held at NASA Headquarters, Wash, DC, p 1-23, Feb 6, 1969. 23 p, 12 fig, 1 tab, 7 ref.

Descriptors: *Fog, *Reviews, *Weather modification, Cloud physics, Atmospheric physics, Cloud seeding, Nucleation, Halides, Meteorology, Weather, Research and development.
Identifiers: Fog dispersal, Visibility, Fog physics.

A general review is given of a project to investigate basic warm fog properties and dynamics, and to evaluate suggested methods for suppression of warm fog. Investigations of basic fog properties included literature studies, fog modeling, fog climatologies, experimental investigations aimed at the description of fog, and studies of condensation nuclei that are activated to droplet growth in fog. These studies were all aimed at the development of a better understanding of what fog is, how it forms and why it creates a problem. (Knapp-USGS)
W70-02857

**PROGRESS OF NASA RESEARCH ON WARM FOG PROPERTIES AND MODIFICATION CONCEPTS.**

Report available from Clearinghouse for $3.00 in paper copy, $0.65 in microfiche. NASA Special Publication Report SP-212, Proceedings of Symposium held at NASA Headquarters, Wash, DC, Feb 6, 1969. 122 p, 44 fig, 6 tab, 14 ref.

Descriptors: *Fog, *Cloud seeding, *Reviews, Weather modification, Clouds, Nucleation, Silver iodide, Halides, Cloud physics, Meteorology, Weather, Airports.
Identifiers: Fog dispersal, Visibility, Airport operation.

A NASA symposium was held to review recent work in warm fog dispersal. Theoretical analyses and laboratory experiments were used to explore various warm fog modification concepts and catalog the noteworthy aspects of each concept. The seeding concept using sized hygroscopic nuclei was developed and tested in fog chamber experiments. The small amounts of the seeding material needed to significantly modify the fog and greatly increase visibility in these experiments were encouraging. The Symposium is a progress report, recognizing that there is work yet to be done before warm fog will no longer be an obstacle to routine aircraft operation. One objective was to provide results of recent warm fog seeding field experiments at the Chemung County Airport, Elmira, New York, and laboratory experiments at the Cornell Aeronautical Laboratory facility to evaluate several seeding materials. Another objective was to provide a forum for others to present and discuss their fog research programs and for aircraft users to define the operational needs of a practical fog modification system for airports. (Knapp-USGS)
W70-02858

**GROUNDWATER INVESTIGATION, MOUNT KOBAU, BRITISH COLUMBIA,**
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-02867

**THE PRECIPITATION REGIME OF LONG ISLAND, NEW YORK,**
Weather Bureau, Silver Spring, Md.
J. F. Miller, and R. H. Frederick.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402. Geological Survey Professional Paper 627-A, p A1-A21, 1969. 21 p, 23 fig, 1 plate, 7 tab, 16 ref.

Descriptors: *Precipitation (Atmospheric), *Weather, *Climates, *New York, Hydrologic cycle, Rainfall, Synoptic analysis, Weather data, Data collections, Climatic data, Climatology, Meteorological data, Weather patterns.
Identifiers: *Long Island (NY).

Mean annual precipitation ranges from 40 to 50 inches over Long Island, New York and averaged about 43 inches for the analysis period 1951-65. The average precipitation is greatest over the central part of the Island. This may be due to (1) greater distance of this area from the stabilizing effects of the Atlantic Ocean and Long Island Sound, and (2) its slightly higher altitude. Average warm-season and cool-season precipitation are almost equal. The number of days with precipitation equal to or less than 1.00 inch is randomly distributed geographically but shows a definite seasonal variation, being greatest in the spring and least in the fall. The number of days with precipitation of more than 1.00 inch and the amount of rain that falls on such days are both highly correlated with average seasonal and monthly precipitation. About 5-10% of the water equivalent of cool-season precipitation is in the form of snow. (Knapp-USGS)
W70-02881

**SEASONAL VARIATION IN RAIN GAGE CATCH,**
Department of Agriculture, Washington, D.C.; and Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 07B.
W70-03086

**RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03151

## 2C. Snow, Ice, and Frost

**LICHENOMETRY TO EVALUATE CHANGES IN GLACIAL MASS BUDGETS: AS ILLUSTRATED FROM NORTH-CENTRAL BAFFIN ISLAND, N.W.T.,**
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02I.
W70-02873

**GLACIAL GEOMORPHOLOGY AND CHRONOLOGY OF HENRY KATER PENINSULA, EAST BAFFIN ISLAND, N.W.T.,**
Nottingham Univ. (England). Dept. of Geography.
Cuchlaine A. M. King.
Arctic and Alpine Research, Vol 1, No 3, p 195-212, Summer 1969. 18 p, 11 fig, 2 tab, 16 ref.

Descriptors: *Glaciation, *Glaciers, *Geomorphology, *Arctic, *Sediments, Ice, Marine geology, Fjords, Mountains, Valleys, History, Mapping, Erosion, Rivers, Lakes, Deltas, Sea level, Stratigraphy.
Identifiers: *Canada, East Baffin Island, Glacial geomorphology.

Henry Kater Peninsula, East Baffin Island, was ice covered at least between 34,000 and 10,000 BP. The ice advanced into the sea along the outer part of the peninsula, spreading a thin morainic covering over shell-bearing marine sediments. Ice moved inland from the fjords along the margins of the peninsula, while ice from inland covered the interior. Much ice decayed in situ, leaving extensive dead-ice areas. The sea was relatively high as the ice withdrew. Deglaciation took place about 10,000 BP at the outer coast, about 8,500 BP in Isabella Bay on the north side, and 8,000 BP in Itirbilung Bay on the south side. The last major incursion of fjord ice into the embayments along the inner peninsula was approximately 8,700 and 8,000 BP. This moraine may be contemporaneous with the Cockburn moraines. The ice-cored moraines of the present glaciers in the mountain valleys have been static for several years. (Gabriel-USGS)
W70-02874

**HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 1. THE GROWTH RATE OF ICE CRYSTALS IN FLOWING SUB-COOLED WATER,**
Syracuse Univ., N.Y.
For primary bibliographic entry see Field 03A.
W70-03073

**HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 2. THE RATE OF FORMATION OF FREON 31 HYDRATE,**
Syracuse Univ., N.Y.
For primary bibliographic entry see Field 03A.
W70-03074

**THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS: 2. A SIMPLIFIED METHOD OF CALCULATION,**
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 05C.
W70-03089

## 2D. Evaporation and Transpiration

**COMPARISON OF VARIOUS METHODS OF DETERMINING EVAPORATION IN AN IRRIGATED FIELD IN THE VAKHSH VALLEY OF TADZHIKISTAN,**
L. P. Lapshova.
Transl from Trudy GGO, No 230, p 109-116, 1968. Soviet Hydrology: Selected Papers, No 4, p 354-359, 1968. 2 fig, 2 tab, 16 ref.

Descriptors: *Thermal radiation, *Evaporation, Irrigated land, Lysimeters, Cotton, Evapotranspiration, Soils, Soil moisture.
Identifiers: *USSR, Tadzhikistan, Vakhsh Valley.

Thermal-balance was found to be the best method for determining the total evaporation from the cotton-growing areas. Lysimetry is another method used in irrigated regions. Total evaporation in the Vakhsh Valley, Tadzhikistan can be computed from the radiation balance of an irrigated field. However, this method yields reliable results only during the budding-flowering and ripening phases of the cotton. Evaporimeter data can be used to calculate evaporation when information on the radiation balance is not available. (Carstea-USGS)
W70-03116

**EVAPORATION WATER LOSSES UNDER SPRINKLING IRRIGATION CONDITIONS (RUSSIAN),**
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
V. A. Anisimov, and M. S. Mansurav.
Gidrotekhnika i Melioratsiya, No 8, p 37-43, Aug 1969. 5 fig, 1 tab, 10 ref.

Descriptors: *Evaporation, *Water loss, *Sprinkler irrigation, *Air temperature, Irrigation systems, Crop production, Pipelines, Raindrops, Humidity, Wind velocity, Meteorology.
Identifiers: *USSR, Sprinkling irrigation water loss.

The effects of wind, air temperature, type of crop, and sprinkler-nozzle dimension on water loss by evaporation, using sprinkler irrigation, were analytically and experimentally investigated during 1965-1967. In arid areas, the use of minimal sprinkling intensity is justified only until a limit is reached. Discrete sprinkling of low intensity covering a small area may lead to a considerable water loss by evaporation from the plant leaves. (Gabriel-USGS)
W70-03121

**COMPARATIVE PLANT WATER RELATIONS,**
Aberdeen Univ. (Scotland). Dept. of Botany.
P. G. Jarvis.
Annals of Arid Zone, Vol 6, No 1, p 74-91, 1967. 101 ref.

Descriptors: *Soil-water-plant relationships, *Leaves, *Moisture stress, *Atmosphere, *Transpiration, Plant growth, Metabolism, Field capacity, Stomata, Drought resistance, Root distribution, Solar radiation, Heat balance, Osmotic pressure, Turgidity, Plant physiology, Surfaces, Moisture content, Soil moisture.
Identifiers: *Water potential.

A review is made of the extensive modern literature on plant-water relations and plant physiology to develop a broad discussion of current knowledge of water relations within plants and ways that different features of species may affect their response to a limited water supply. Transpiration is an energy-dependent process; when water is freely available the transpiration rate depends largely on atmospheric conditions. With moisture stress the system ceases to be the direct result of atmospheric conditions but is modified by the plant. Effects of moisture stress on plant metabolism and growth are influenced by 2 groups of plant factors: (1) Those factors affecting water potential in leaves: rooting habit of the plant, resistance to water passage from roots to leaves, and influence of plant surfaces on transpiration, (2) Influence of leaf water potential on physiology of growth: relationship between leaf water potential and turgidity, relationship between turgidity and stomatal aperture and direct effects of low turgidity and water potential on metabolism. Each of these aspects is presented individually with quantitative expressions developed where possible and relevant. Possible differences in influence of the various factors in different types of plants are also discussed. There are many plant factors of varying importance which determine the response of a particular plant population to water stress. None of these has been studied in sufficient detail to make objective assessments of its relative importance among the species. (Crouse-Arizona)
W70-03239

## 2E. Streamflow and Runoff

**FLOOD PLAIN INFORMATION, AMERICAN FORK AND DRY CREEK, AMERICAN FORK AND LEHI, UTAH.**
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-02866

**WATER AND RELATED LAND RESOURCES, CENTRAL LAHONTAN BASIN - WALKER RIVER SUBBASIN NEVADA-CALIFORNIA.**
Nevada River Basin Survey, Carson City.

Department of Agriculture Cooperative Survey Report, June 1969. 232 p, 23 fig, 75 photo, 9 map, 39 tab, 103 ref, 2 append.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Nevada, *California, Water yield, Water utilization, Streamflow, Aquifers, Irrigation water, Domestic water, Economics, Water resources development, Water management (Applied), Water rights, Water law.
Identifiers: *Walker River (Nev-Calif).

A report of the water resources of Walker River Subbasin, Calif-Nev, includes an inventory of the natural resources and problems; an analysis of economic development; a short discussion of existing resource projects and programs; and an indication of the opportunities for development. The Walker River Subbasin is one of three subbasins within the Central Lahontan Basin. Of the 2,733,660 acres in the subbasin, 595,700 acres are in California and 2,137,960 acres in Nevada. The Walker River drainage heads in the Sierra Nevada in California, and flows into Nevada, where it terminates in Walker Lake. Presently, about 119,870 acres are irrigated, with alfalfa and pasture the chief crops grown. The 50% chance water yield (5 out of 10 yr) was approximately 396,800 acre-feet; the 80% chance water yield is about 293,600 acre-feet. An estimated 232,600 acre-ft are used by the crops from surface flows. Approximately 34,600 acre-ft were pumped from groundwater in the two major irrigated valleys (Smith and Mason Valleys), in 1964. Total amount of water available from underground sources is estimated to be 6,500,000 acre-ft; however, total recharge to the groundwater supply is only about 206,000 acre-ft; during a 50% chance water year. Much of the subbasin is subject to both wet- and dry-mantle floods. (Knapp-USGS)
W70-02868

**FORECASTING THE RHINE RIVER DISCHARGES (FRENCH),**
Electricite de France, Grenoble. General Technical Div.
F. Lugiez, P. Kasser, H. Jensen, and P. Guillot.
English summary. Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 91-116, Sept 1969. 26 p, 14 fig, 6 tab, 24 ref.

Descriptors: *Stream flow forecasting, *River flow, *Flood forecasting, Hydrologic data, Lakes, Rainfall, Snow, Runoff, Seasonal, River basins, Watersheds (Basins), Mapping, Gaging stations, Statistical methods, Hydrograph analysis, Correlation analysis, Frequency.
Identifiers: *Rhine river, Discharge forecasting.

Forecasts of the discharge of the Rhine River have been studied in Zurich since 1954 in cooperation with the power and water management organizations of Switzerland, Germany, France, and the Netherlands. Annual forecasts are made of the water yield from snowmelt data. For short-term forecasts, the significant predictors are discharge and rainfall, and for long-term forecasts, the alpine snow pack and the levels of the Swiss lakes play an important role. These forecasts are used by the hydropower plants in their operation programs, maintenance, and proper timing of construction work. (Gabriel-USGS)
W70-02884

**HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASCAGOULA QUADRANGLE, MISSISSIPPI,**
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-406, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Pascagoula (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Pascagoula quadrangle shows flooded areas on a topographic map scaled 1:62,500. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02888

**HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GRAND BAY QUADRANGLE, ALABAMA,**
Geological Survey, Washington, D.C.
K. V. Wilson, and J. W. Hudson.

For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-408, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Alabama, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Grand Bay (Ala), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Miss. - Ala. Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Grand Bay quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area, Miss. where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02889

**HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BILOXI QUADRANGLE, MISSISSIPPI,**
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-404, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Biloxi (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Biloxi quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02890

**CAUSES OF FLOODING OF LITTLE CHARLEY BOWLEGS CREEK UPSTREAM FROM HIGHLANDS HAMMOCK STATE PARK, FLORIDA,**
Geological Survey, Tallahassee, Fla.
W. R. Murphy, Jr.
Geological Survey Open-file Report, 1968. 16 p, 11 fig.

Descriptors: *Flooding, *Florida, *Stage-discharge relations, Dams, Profiles, Flood damage, Rainfall-runoff relationships, Regulation, Streamflow, Backwater, Flow profiles, Reservoirs, Water levels.
Identifiers: Highland Hammocks State Park (Fla).

Complaints of flooding on Little Charley Bowlegs Creek, Florida, led to an investigation of the effects of a dam in Highlands Hammock State Park on backwater conditions upstream in low-lying pastures. The concrete dam creates a nearly level conservation pool within the park during low water. Little or no backwater from the dam (without flashboards) extends beyond the park boundary during flood stages. The lowlands upstream from the park form a broad, flat marsh that would experience flooding following heavy rains even if there were no dam. No channel constrictions occur within the park which would cause backwater in the park or upstream from the park. The channel upstream from the south park boundary is inadequate to convey flood flows to the park because of: (1) lack of adequate slope, (2) small cross-sectional area, and (3) its clogged condition due to vegetation. Flooding of lowlands upstream from the park is attributable chiefly to these factors. (Knapp-USGS)
W70-03071

**ON THE VALIDITY OF UNIT HYDROGRAPH THEORY,**
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, Basil Anderson, and Ven Te Chow.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 20 p. NSF Grant GK-1155.

Descriptors: *Hydrograph analysis, *Theoretical analysis, *Dimensional analysis, *Rainfall-runoff relationships, Runoff, Froude number, Reynolds number, Laminar flow, Turbulent flow, Unit hydrographs.
Identifiers: Kinematic wave theory.

Through dimensional analysis and the examination of the characteristics of the equation of motion describing watershed runoffs it is demonstrated that the linearity assumption of the unit hydrograph theory is only an approximation. The Reynolds number, R, and Froude number, F, of the flow and a parameter expressing surface detention storage are the important factors affecting the shape of the unit hydrograph. Quantitative evidence of the approximation of the linearity assumption is given by approximate theoretical solutions based on (1) Stokes range flow and (2) kinematic wave theory applied to both laminar and turbulent flow. Laboratory and field experimental data are also analyzed and the nonlinear characteristics of the unit hydrograph are clearly shown. (Carstea-USGS)
W70-03076

**THE NORTH BOSQUE WATERSHED INVENTORY OF A DRAINAGE BASIN,**
Baylor Univ., Waco, Tex. Dept. of Geology.
Cleo V. Proctor, Jr.
Report available for sale from Department of Geology, Baylor University, Waco, Texas, 76703, Price $1.04 postpaid. Baylor Geological Studies Bulletin No 16, Spring 1969. 40 p, 26 fig, 3 tab, 51 ref, append.

Descriptors: *River basins, *Texas, *Hydrologic data, *Data collections, Surveys, Watersheds (Basins), Streamflow, Sediment yield, Erosion, Geomorphology, Floods, Topography, Rainfall-runoff relationships, Geology, Hydrogeology, Water quality.
Identifiers: *North Bosque Watershed (Tex).

The geomorphology of the four physiographic regions within the North Bosque watershed, Texas, is directly related to the properties of the rocks outcropping within those regions, and a dynamic equilibrium exists between erosional energy and topography. Landforms are being downwasted at the same rate, and differences in relief and form can be explained in terms of spatial relationships rather than evolutionary development through time. Because of the location of the North Bosque watershed, flood discharges reaching the magnitude of 500,000 cfs can be expected during a long period of record. Sheet erosion is the major sediment producer in the North Bosque watershed. Sheet erosion lowers the land surface by a maximum of approximately 0.095 cm/yr. Solution is also important and lowers the land surface by approximately 0.0012 cm/yr. In the North Bosque watershed several empirical relationships are given to relate geomorphology, hydrology, and erosional energy. (Knapp-USGS)
W70-03077

**FLOOD PLAIN INFORMATION, KERN RIVER, BAKERSFIELD, CALIFORNIA.**
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-03090

**WATER, EARTH AND MAN: 2. WORLD WATER INVENTORY AND CONTROL,**
Geological Survey, Washington, D.C.
R. L. Nace.
London, England, Methuen and Company, Limited, p 31-42, 1969. 12 p, 2 tab, 11 ref.

Descriptors: *Water resources, *Water storage, *Water resources development, *Surveys, Groundwater, Surface waters, Water sources, Reviews, Water quality, Rivers, Lakes, Ice, Glaciers.
Identifiers: Water resources inventories.

The status of the world's water inventory activity is briefly outlined in a chapter of a broad survey of Man's relation to water resources. The topics reviewed include uses of water resources inventories, the hydrologic cycle, river discharge, channel storage, lakes, inland seas, groundwater storage, ice, and water resources development. (See W70-03095). (Knapp-USGS)
W70-03096

**HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, OCEAN SPRINGS-DEER ISLAND QUADRANGLES, MISSISSIPPI,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03097

**FLOODS OF APRIL 28, 1966, IN THE NORTHERN PART OF DALLAS, TEXAS,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03098

**FLOODS OF JUNE 1965 IN SOUTH PLATTE RIVER BASIN, COLORADO,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03100

**FLOODS IN NEW YORK-1968,**
Geological Survey, Albany, N.Y.
F. Luman Robison.
New York Water Resources Commission Report of Investigation RI-9, 1969. 30 p, 6 fig, 1 tab.

Descriptors: *Floods, *New York, *Flood damage, Discharge (Water), Stage-discharge relations, Data collections, Hydrologic data, Streamflow, Flood plains, Floodwater, Rainfall, Precipitation (Atmospheric).
Identifiers: Flood data.

Information is presented on floods reported in New York State during the calendar year 1968. The information was obtained from newspaper clippings, from the U.S. Weather Bureau publications 'Storm Data and Unusual Weather Phenomena, 1968' and 'Daily Precipitation Records,' from records of the U.S. Geological Survey, and from reports of the U.S. Army Corps of Engineers. Floods were reported someplace in New York in every month of 1968, but at most sites the resulting damage was not great. The most serious flood event of the year occurred in the southeastern part of the State at the

end of May. Heavy rain began about 10 pm on May 28 and ended before noon the next day. The maximum measurement of 5.54 inches was recorded at Dobbs Ferry, Westchester County. At Central Park in New York City a reading of 4.88 inches broke a 60-yr record for 24-hr rainfall. Peak discharges for many streams in the flood area are tabulated with corresponding maximum peaks of record prior to May 29 for comparison. (Knapp-USGS)
W70-03103

**FLOODS OF AUGUST 1967 IN MARYLAND AND DELAWARE,**
Geological Survey, Towson, Md.
D. H. Carpenter, and R. H. Simmons.
Geological Survey Open-file Report, 1969. 98 p, 36 fig, 1 tab.

Descriptors: *Floods, *Maryland, *Delaware, *Rainfall, *Historic flood, Data collections, Gaging stations, Hydrologic data, Discharge (Water), Flood damage, Erosion, Rainfall-runoff relationships, Stage discharge relations, Precipitation intensity.
Identifiers: Flood records, Crest-gage stations.

Intense rainfall associated with severe thunderstorm activity during several periods in August 1967 caused considerable flooding throughout much of Maryland and Delaware. Precipitation intensities up to 2-1/2 inches in 1 hour and totals up to 9 inches in 6 hours were experienced. Total recorded rainfall for the month ranged from less than 5 inches in western Maryland to 19 inches on the Eastern Shore, in the wettest month since August 1955. Extensive damage was done. Numerous dams, bridges, culverts, and portions of roadways were washed out. Total damage was estimated to be more than $1,700,000. Discharge data are presented for 61 regular gaging stations, 30 crest-gage stations, and 3 miscellaneous sites. Maximum peaks of record occurred at 20 of the regular gaging stations. The maximum peak discharge rate recorded was 1,190 cfs per sq mi. (Knapp-USGS)
W70-03104

**ATTEMPT AT AN ESTIMATE OF BANK REGULATION OF STREAMFLOW IN THE BASIN OF THE SEVERSKIY DONETS RIVER,**
V. P. Yunitsyna.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 122-130, 1968. Soviet Hydrology: Selected Papers, No 4, p 393-400, 1968. 3 fig, 2 tab, 10 ref.

Descriptors: *Bank storage, *River flow, Rivers, Channels, Water level fluctuations, Groundwater recharge, Surface waters, Soil moisture, Statistical methods, Equations, Surface-groundwater relationships.
Identifiers: *USSR, *Severskiy Donets River.

The quantitative aspects of the bank regulation process are important in understanding relationships between surface and groundwater. Computations were made for reaches of the main Donets River and for the other tributaries of the drainage system, using aerial photographs, hydrographic, hydrometric, and hydrogeologic data. The data obtained were: (1) daily water volumes in the channel and banks; (2) variation in bank volumes in time and along the river; (3) daily volumes of inflow to the channel network. For example, during the 1963 flood when the river level rose 4 m, the amount of water accumulated in the banks was 46 million cu m. By contrast, only 4.75 million cu m seeped into the ground when the river level rose only 2.3 m. (Carstea-USGS)
W70-03106

**HYDROMORPHOLOGICAL PRINCIPLES OF COMPUTATIONS OF FREE MEANDERING: 1. SIGNS AND INDEXES OF FREE MEANDERING,**
For primary bibliographic entry see Field 02J.
W70-03107

**SOME PROBLEMS CONCERNING THE THERMAL REGIME OF RIVERS IN THE ARAKS BASIN,**
For primary bibliographic entry see Field 05A.
W70-03112

**HYDRAULIC COMPUTATION OF FLOOD-PLAIN CHANNELS,**
For primary bibliographic entry see Field 08B.
W70-03113

**CONVERSION OF ANNUAL STREAMFLOW TO A LONG PERIOD,**
A. V. Rozhdestvenskiy.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 3-13, 1968. Soviet Hydrology: Selected Papers, No 4, p 365-374, 1968. 3 fig, 3 tab, 4 ref.

Descriptors: *Data collections, *Steamflow, *Simulation analysis, Equations, Flow, Statistical methods, Monte Carlo method, Rivers, Time series analysis, Hydrologic properties.
Identifiers: *USSR, Neva River, Tikhvinka River.

Annual streamflow is converted to a long period by simulating a short-period hydrologic series for a period for which there are observations at an analogous point. The proposed method can be used to convert series of not less than 15-20 years to a longer period. The method consists of the following steps: (1) Computation of the dynamic normal flow from a given short observation series and from an analogous series; (2) construction of graphs of the relationship between the dynamic flow normals over a common observation period for points with short and long records; and (3) random, uncorrelated fluctuations with respect to the dynamic flow normal are correlated by the Monte Carlo method. These steps are discussed and illustrated with data from the Neva River at Petrokrepost and the Tikhuinka River at Gorelukhi. (Carstea-USGS)
W70-03115

**WATERS OF 'MIDDLE ASIA' (RUSSIAN),**
Akademiya Nauk SSSR, Moscow. Institut Geografii.
N. T. Kuznetsov.
Moscow, Izdatel'stvo 'Nauka', 1968. 272 p, 56 fig, 23 tab, 288 ref.

Descriptors: *Water resources, *Surface waters, Water balance, Water demand, Water chemistry, Water supply, Climatic data, Frost, Groundwater, Glaciers, Lakes, River systems, Bibliographies.
Identifiers: Outer and Inner Mongolia, North China, Middle Asia (USSR).

The hydrology of the Mongolian Peoples' Republic, Inner Mongolia, and several dry provinces in China, in total area over 4,200,000 sq km, is described. The hydrological and chemical characteristics of the rivers, lakes, and water reservoirs were identified and expressed in numerous tables and charts. The water sources of 'Middle Asia' are the snow-melt waters and summer precipitation. In general the formation runoff on 'Middle Asia' takes place higher absolute altitudes than that of Central Asia. The rivers of 'Middle Asia' have later snow floods than those of Central Asia. Topics discussed include: (1) the effect of geographical conditions on the life present in rivers, lakes, and marsh lands; (2) development of rivers and lakes in the Quaternary period; (3) rivers; (4) lakes and marsh lands; and (5) the paths and possibilities of the development of water economy. (Gabriel-USGS)
W70-03117

**FLOOD-PLAIN DRAINAGE AND FLOOD DISCHARGES OF THE UKRAINIAN SMALL RIVERS (RUSSIAN),**
Ukrainian Scientific Research Inst. of Hydroengineering and Land Reclamation (USSR).
G. P. Kubyshkin.
Gidrotekhnika i Melioratsiya, No 8, p 55-59, Aug 1969. 2 fig, 2 tab, 6 ref.

Descriptors: *Drainage, *Flood plains, *Floods, *Rivers, *Floodwater, *Discharge (Water), Climates, Reclamation, Peat, Bogs, Snowmelt, Runoff, Soils, Agricultural engineering, Statistical models, Cost analysis.
Identifiers: *USSR, Flood plain drainage, Ukrainian rivers.

The effect of flood-plain drainage was experimentally investigated by comparing the maximum and minimum discharges of small Ukrainian rivers before and after the introduction of a reclamation drainage system. Analysis of the data collected during the 40-year period shows that the reclamation drainage of flood plains leads to a considerable decrease of runoff magnitudes of both low and high frequencies. This decrease in flood intensity permits the construction of river dams of smaller discharge capacity. (Gabriel-USGS)
W70-03120

**LINEAR ROUTING IN UNIFORM OPEN CHANNELS,**
University Coll., Cork (Ireland). Dept. of Civil Engineering.
J. C. I. Dooge, and B. M. Harley.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 8, p 57-63, 1967. 7 p, 4 fig, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Streamflow forecasting, *Open channel flow, *Mathematical models, Linear programming, Computers, Digital computers, Flood forecasting, Simulation analysis, Flood routing.
Identifiers: Linear routing (Open channel flow).

A general linear solution to the flood routing problem is obtained by solving a linearized equation of motion for a semi-infinite uniform open channel subject to a delta-function inflow at the upstream end. This general linear solution is used to compare the accuracy of the more important special linear procedures used in applied hydrology for flood routing. The effect of varying the reference discharge which is used as the basis of the linearization is also examined. (Knapp-USGS)
W70-03126

**EFFECT OF BASIN MORPHOLOGY ON RESPONSE TO FLOOD FLOWS,**
Oklahoma State Univ., Stillwater. Bioengineering Labs.; and Oklahoma State Univ., Stillwater. Water Resources Research Inst.
For primary bibliographic entry see Field 07C.
W70-03127

**USE OF LOG-TRANSFORMATION TO THE ANALYTICAL REPRESENTATION OF RIVER RUNOFF,**
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
Tsutomu Kishi.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 4, p 25-30, 1967. 6 p, 2 fig.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Statistical methods, *Unit hydrographs, *Hydrograph analysis, Routing, Runoff forecasting, Flood forecasting.
Identifiers: Runoff analysis, Tokoro River (Japan).

The nonlinear character of river runoff has been pointed out by many investigators. Unit graphs derived from different storms for a river basin are not identical, in general, except for some favorable cases in which various integrating influences of the basin smooth out the nonlinearity. A theory is developed to give mathematical expressions to variable distribution graphs or unit graphs. Asymmetric distribution graphs can be transformed to the normal distribution curve by using a log-transformation. The inherent variation of the runoff character is described by assigning a particular set of values for the parameters of a transformation

relationship. Several types of transformation relationships are investigated. Application of the theory to the analysis of runoff for the Tokoro River, Hokkaido, Japan is given as an illustrative example. (Knapp-USGS)
W70-03130

**RUNOFF ANALYSIS AND WATER-BALANCE ANALYSIS BY A SERIES STORAGE TYPE MODEL,**
National Research Center for Disaster Prevention, Tokyo (Japan).
For primary bibliographic entry see Field 02A.
W70-03131

**ANALYTICAL SIMULATION OF WATERSHED HYDROGRAPHS FROM RAINFALL,**
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-03132

**A DISTRIBUTED LINEAR MODEL FOR PEAK CATCHMENT DISCHARGE,**
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02A.
W70-03133

**A MATHEMATICAL WATERSHED ROUTING MODEL,**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-03134

**A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,**
For primary bibliographic entry see Field 07C.
W70-03135

## 2F. Groundwater

**QUEBRADA DE LOS CEDROS, SOUTHWESTERN PUERTO RICO, AND ITS BEARING ON SOME ASPECTS OF KARST DEVELOPMENT,**
Puerto Rico Univ., Mayaguez. Dept. of Geology.
Mounir T. Moussa.
Journal of Geology, Vol 77, No 6, p 714-720, Nov 1969. 7 p, 2 fig, 4 ref.

Descriptors: *Karst, *Structural geology, *Drainage patterns (Geologic), *Puerto Rico, Limestones, Caves, Geomorphology, Erosion, Permeability, Porous media, Fractures (Geology), Joints (Geology).
Identifiers: *Karst development, *Subterranean stream piracy.

The gorge of Quebrada de los Cedros (a tributary of Rio Macana in southwestern Puerto Rico) is a deroofed portion of a complex cavern system through which part of the drainage of Rio Tallaboa was diverted by a process of subterranean stream piracy. The karst features in Quebrada de los Cedros and in other parts of the region indicate that the absence of extensive karst development in the mid-Tertiary limestones in southwestern Puerto Rico is probably due to their lack of mass permeability rather than to insufficient rainfall. The direction of the underground flow in the upper part of the quebrada is against the direction of the dip of the beds, which indicates that the structural control is not critically important in the development of subterranean passageways. Water will move along any plane, whether structurally controlled or not, as long as it has the opportunity to be drained at a lower level under the force of gravity. (Knapp-USGS)
W70-02852

**LAND SUBSIDENCE DUE TO WITHDRAWAL OF FLUIDS,**
Geological Survey, Sacramento, Calif.; and Geological Survey, Washington, D.C.
J. F. Poland, and G. H. Davis.
Geological Society of America, Inc Reviews in Engineering Geology II, p 187-269, 1969. 83 p, 49 fig, 7 plate, 2 tab, 119 ref, index.

Descriptors: *Subsidence, *Withdrawal, *Groundwater, Settlement (Structural), Water wells, Oil wells, Compaction, Pore pressure, Elasticity (Mechanical), Artificial recharge, Clays.
Identifiers: Subsidence-fluid withdrawal relationships.

Land-surface subsidence due to the withdrawal of fluids by man has become relatively common in the United States since 1940 and has been described at several other places throughout the world. Known examples of appreciable land subsidence are reviewed. Those related to exploitation of oil and gas fields include Goose Creek, Texas; Wilmington, California; Lake Maracaibo, Venezuela; Niigata, Japan; and the Po Delta in Italy. The areas related to groundwater withdrawal include areas in Japan; Mexico City, Mexico; and Texas, Arizona, Nevada, and California. The areas of greatest extent and maximum subsidence are in California. The principles involved in the compaction of sediments and of aquifer systems are examined briefly. The amount of compaction that a confined aquifer system will experience is a function of compressibility. Other factors that influence compaction (and, in part, compressibility) include particle size and shape, clay mineralogy, geochemistry of pore water in the clayey beds and of the water in contiguous aquifers, and secondary compression. Subsidence problems are alleviated by cessation of withdrawal and increase or restoration of reservoir pressure. The greatest control measures are taken at Wilmington, California, where subsidence of 27 feet is nearly stopped; in addition, significant rebound has occurred. (Knapp-USGS)
W70-02861

**NUCLEAR BLAST RESISTANT WATER WELLS,**
Naval Civil Engineering Lab., Port Hueneme, Calif.
For primary bibliographic entry see Field 08A.
W70-02865

**GROUNDWATER INVESTIGATION, MOUNT KOBAU, BRITISH COLUMBIA,**
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
E. C. Halstead.
Inland Waters Branch Technical Bulletin No 11, Department of Energy, Mines and Resources, 1969. 14 p, 14 fig, 3 tab, 2 ref.

Descriptors: *Water supply, *Groundwater, *Hydrogeology, *Hydrologic budget, Water wells, Recharge, Groundwater movement, Discharge (Water), Aquifers, Streamflow, Snowmelt, Water levels, Water storage, Reservoirs.
Identifiers: *Canada, Mt. Kobau (British Columbia), Aquifer testing.

The groundwater budget of Mt. Kobau, British Columbia was studied by drilling 5 test wells and testing a production well drilled for the water supply of a proposed Canadian National Observatory site. The flow of Testalinden Creek is maintained by the storage, movement and discharge of groundwater in fractured bedrock which outcrops at the summit of Mount Kobau. The groundwater is recharged annually by snowmelt. The pump test was continuous for 47 hours at a rate of 7.5 imperial gpm with a drawdown of 52.2 feet. During the 1967 calendar year, total precipitation was 20.91 inches, of which 3.61 inches fell as rain and the remaining 17.30 inches, as snow. The groundwater recharge into the fractured bedrock depends upon the volume of snowmelt. The thin overburden, which functions as a permeable mantle beneath the snow cover, retains a significant volume of meltwater long enough to enable recharge to continue well beyond the peak of the melting season. Groundwater recharge at the summit is sufficient to sustain a minimum base flow in Testalinden Creek of 0.2 imperial gpm. (Knapp-USGS)
W70-02867

**WATER AND RELATED LAND RESOURCES, CENTRAL LAHONTAN BASIN - WALKER RIVER SUBBASIN NEVADA-CALIFORNIA.**
Nevada River Basin Survey, Carson City.
For primary bibliographic entry see Field 02E.
W70-02868

**OBSERVATIONS ON WATER CONTENT CHANGES IN STRATIFIED SEDIMENTS DURING PIT RECHARGE,**
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 04B.
W70-02887

**A METHOD OF ANALYZING TRANSIENT FLUID IN MULTILAYERED AQUIFERS,**
Pahlavi Univ., Shiraz (Iran); California Univ., Berkeley.
Iraj Javandel, and Paul A. Witherspoon.
Water Resour Res, Vol 5, No 4, p 856-869, Aug 1969. 14 p, 10 fig, 13 ref.

Descriptors: Transients, *Unsteady flow, *Aquifers, Methodology, Theis equation, Fluid flow, *Groundwater flow, Anisotrophy, Permeability, Drawdown, Numerical analysis, Groundwater, Pumping, Analysis.
Identifiers: *Transient flow, Finite element method, Two-part aquifers, Boundary conditions.

A new approach to transient fluid flow in multilayered aquifers of anisoptropic systems was developed using the finite element method. This is a numeric technique in which an initial boundary value problem is converted to a variational problem and applied to a discrete system of elements. The method was used to investigate potential distributions in multilayered aquifers of finite radial extent being pumped at constant rate using completely penetrating wells. An analysis of 2-layer systems with permeability contrasts of up to 100:1 indicates that at early time the drawdown behavior can vary significantly from the Theis solution, depending on where observations are made. As time increases, results converge on the Theis solution, regardless of the permeability contrast. A 13-layer aquifer containing either isotropic or anisotropic layers was also examined. Results are in general agreement with the behavior for 2-layer systems. (USBR)
W70-02943

**THE CONVOLUTION RELATION AS APPLIED TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
Allen F. Moench, and Chester C. Kisiel.
Available from the Clearinghouse as PB-189 083, $3.00 in paper copy, $0.65 in microfiche. Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 20 p. OWRR Grants No B-007-ARIZ, and A-010 WRRC-ARIZ.

Descriptors: *Surface-groundwater relationships, *Model studies, *Mathematical models, Induced infiltration, Observation wells, Equations, Groundwater movement, Groundwater recharge, Aquifer characteristics, Channel morphology, Recharge, Water yield, Water levels, Ephemeral streams, Hydrogeology.
Identifiers: Hydrologic model studies.

A linear model is presented which enables one to estimate recharge from a source of finite width and infinite length given water level measurements in an observation well. The method requires solution

of the inverse problem of finding the system input given the system output (water level measurements) and the system impulse response function. The impulse response function is derived from the linear equations of groundwater motion for the particular geometry of this study. The discrete form of the convolution integral is rearranged so as to obtain the system input (timewise variation of recharge) by the method of synthetic division. Aquifer constants are estimated independently. Total recharge is obtained by integrating the system input over the appropriate time period. For the particular event and location of this study, results are in good agreement with an independent estimate of recharge. (Carstea-USGS)
W70-03064

**ELECTRICAL RESISTIVITY SURVEY IN THE PIEDMONT AREA, ALABAMA,**
Alabama Geological Survey, University; and Auburn Univ., Ala. Water Resources Research Inst.
W. Leon Scarbrough, Thomas J. Joiner, and James C. Warman.
Geological Survey of Alabama Circular 57, 1969. 20 p, 11 fig, 3 plate, 34 ref. OWRR Proj No A-009-ALA.

Descriptors: *Electrical studies, *Resistivity, *Subsurface mapping, *Groundwater, *Alabama, Weathering, Geology, Surveys, Aquifers, Geophysics, Structural geology, Faults (Geology), Fissures (Geology), Hydrogeology.
Identifiers: Groundwater prospecting.

Electrical resistivity investigations were made in the Piedmont of Alabama by assuming that weathered or solutionally enlarged water-bearing openings along fractures in the bedrock would be more conductive than solid unaltered bedrock and would be indicated as conductive anomalies. A semi-empirical method using the bedrock surface as a datum plane was used. Approximately 12 square miles in and around the town of Heflin and 2 square miles about 10 miles southeast of Heflin were included in this study. When electrical resistivity methods are correlated with other geophysical data and with geologic, hydrologic and topographic data they are valuable tools for solving groundwater problems. Resistivity anomalies were interpreted to indicate sand and gravel deposits in alluvium, and deeply weathered fracture zones in saprolite and bedrock, caused by localized occurrence and movement of groundwater. Lateral changes in the lithology of alluvium and saprolite have also been interpreted. (Knapp-USGS)
W70-03067

**DATA FROM TEST DRILLING FOR PUBLIC WATER SUPPLIES IN LOUISIANA - JULY 1966 THROUGH JUNE 1967,**
Geological Survey, Baton Rouge, La. Water Resources Div.
J. L. Snider.
Geol Surv Open-file Rep, 1969. 133 p, 1 fig, 4 ref.

Descriptors: *Data collections, *Hydrologic data, *Water wells, *Louisiana, Aquifers, Particle size, Sands, Water quality, Water supply, Municipal water.
Identifiers: Test holes.

Geologic and hydrologic data were obtained from test holes and test wells drilled for the Louisiana Department of Public Works to aid communities and State facilities seeking sources of groundwater. The data are from 72 test holes, 74 test wells, and 3 supply wells drilled at 44 communities or State facilities between July 1, 1966, and June 30, 1967. Data given include physical data on test holes, physical and construction data on test and supply wells, grain-size and sand-thickness and depth tables, and chemical analyses of water samples from test and production wells. (Knapp-USGS)
W70-03080

**THEORETICAL ANALYSIS OF REGIONAL GROUNDWATER FLOW,**
California Univ., Berkeley.
R. A. Freeze.
Inland Waters Branch Scientific Series No 3, Department of Energy, Mines and Resources, Ottawa, Canada, 1969. 200 p, 31 fig, 63 ref, 2 append.

Descriptors: *Mathematical models, *Computer programs, *Groundwater movement, Mathematical studies, Computer models, Flow nets, Water levels, Water level fluctuations, Water yield, Safe yield, Recharge, Discharge (Water), Mapping, Water table, Model studies, Groundwater basins.
Identifiers: *Canada, Groundwater basin analysis.

A mathematical model representing steady-state regional groundwater flow in a three-dimensional, nonhomogeneous, anisotropic groundwater basin is developed. Two independent methods of solution are presented: the analytical separation of variables technique is used to solve the two-dimensional, 3-layer case; the numerical finite-difference approach is used to solve the general case. The numerical method is more versatile, mathematically simpler, and well-suited to computer-oriented methods of data storage. Computer programs are presented for both methods; the output consists of plotted potential nets from which flow patterns can be constructed. The potential patterns for over 70 hypothetical cases are presented to illustrate the qualitative and quantitative control exerted on the flow system by: (a) the 'depth/lateral extent' ratio of the groundwater basin; (b) the configuration of the water table; and (c) the geologic configuration and resultant permeability contrasts. The concept of 'natural basin yield' is introduced. The mathematical model approach using numerical solutions and the digital computer can be used both as a reconnaissance tool preceding field investigation and as an interpretive tool following the field program. The results of mathematical model analyses on two actual groundwater basins in the Canadian prairies are presented. (Knapp-USGS)
W70-03084

**GROUNDWATER DEVELOPMENT IN IDAHO - 1968,**
Idaho Dept. of Reclamation, Boise.
Dale R. Ralston.
Idaho Department of Reclamation Water Information Bulletin No 10, May 1969. 24 p, 14 fig, 3 tab.

Descriptors: *Water resources development, *Idaho, *Groundwater, Water wells, Aquifers, Water supply, Water rights.
Identifiers: Groundwater development (Idaho).

Groundwater development in Idaho increased in activity in 1968 with 55% more applications approved to appropriate groundwater and 70% more wells reported drilled than in 1967. A large portion of the increase in filings was the result of small irrigation or domestic filings. The Boise River area was the center of groundwater development in the state, in both applications approved and wells reported drilled. The south Snake Plain areas, Aberdeen-Springfield, Minidoka-Jerome, and Wood River, are also important areas with respect to the ultimate groundwater development of the state. These areas included about one-third of the total quantity appropriated in 1968 and are located on the very productive Snake Plain aquifer. Agricultural growth will be influenced by decisions concerning desert land entries and by the general availability of surface water. (Knapp-USGS)
W70-03094

**WATER, EARTH AND MAN: 3. HUMAN USE OF GROUNDWATER,**
Geological Survey, Washington, D.C.
R. L. Nace.
London, England, Methuen and Company, Limited, p 285-294, 1969. 10 p, 3 fig, 15 ref.

Descriptors: *Water utilization, *Water sources, *Groundwater, *Water resources development, Surveys, Reviews, History, Saline water intrusion, Water pollution.
Identifiers: Groundwater utilization.

Groundwater use is briefly outlined in a chapter of a broad survey of Man's relation to water resources. The topics reviewed include groundwater sources, the groundwater part of the hydrologic cycle, climatic effects, water management, artificial recharge, pollution, and saline water intrusion. (See W70-03096). (Knapp-USGS)
W70-03095

**HYDROGEOLOGY AND GROUNDWATER RESOURCES OF THE GRAVELBOURG AQUIFER, SASKATCHEWAN,**
California Univ., Berkeley.
R. Allan Freeze.
Inland Waters Branch Scientific Series No 6, Department of Energy, Mines and Resources, Ottawa, Canada, 1969. 60 p, 31 fig, 14 tab, 38 ref, 2 append.

Descriptors: *Hydrogeology, *Aquifers, *Glacial drift, *Gravels, *Sands, Permeability, Transmissivity, Recharge, Discharge (Water), Groundwater movement, Storage coefficient, Water quality, Water chemistry, Water utilization.
Identifiers: *Canada, *Gravelbourg (Saskatchewan).

The groundwater flow pattern in the Gravelbourg aquifer, Saskatchewan was delineated by a number of hydrogeological mapping techniques. Quantitative characteristics of the aquifer were determined from one pumping test. The aquifer consists of stratified Pleistocene glacial sand together with associated thin outwash, overlain by less-permeable Pleistocene sediments, and is underlain by poorly permeable shale. The bedrock surface in the Gravelbourg area is a broad valley opening to the northeast, which controls the extent of the stratified drift. Flow through the aquifer is essentially horizontal, with some discharge occurring through the overlying sediments. The major discharge is into Old Wives Lake. Recharge occurs through the glacial till and the silty clay phase of the stratified drift from the adjacent morainal upland areas and from the upstream part of the overlying plain. The water from the aquifer is a sodium sulfate type, with 2500 to 5500 ppm dissolved solids, barely potable without treatment, and unsuitable for irrigation. The maximum transmissibility of the aquifer is 5200 Imperial gpd per ft and the coefficient of storage is 0.00092. The horizontal permeability is 104 Imperial gal/day/sq ft. The vertical permeability of the glacial till is in the order of 3-20 gal/day/sq ft, as determined by tritium dating and pump testing evidence. The safe yield of the aquifer is 280 acre-ft per yr; present utilization is 56 acre-ft per yr. (Knapp-USGS)
W70-03105

**ACCURACY OF WELL DISCHARGE COMPUTATIONS FROM CURVES OF THE DISCHARGE AS A FUNCTION OF THE DROP IN WATER LEVEL (TAKING THE DZHEZKAZGAN REGION AS AN EXAMPLE),**
For primary bibliographic entry see Field 04B.
W70-03114

**ON THE TRANSFER FUNCTION OF LIMITED POROUS MEDIA,**
Toulouse Univ. (France). Institut de Mecanique des Fluides.
Claude Thirriot, and Jean Pierre Villeneuve.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 28, p 211-217, 1967. 7 p, 5 fig.

Descriptors: *Unsteady flow, *Porous media, *Model studies, *Hydraulic models, *Surface-groundwater relationships, Groundwater movement, Induced infiltration, Infiltration, Discharge (Water), Water levels, Water level fluctuations.
Identifiers: Boussinesq equation.

Unsteady periodical flow is studied in porous media lying between two tanks representing lakes, rivers, or channels. One tank level varies sinusoidally. This problem is examined both theoretically, using two linearizing processes of Boussinesq's equation, and by experimental devices including a glass-marble model. Curve boards showing fluctuation amplitude and phase in each medium point show the influence of frequency and ratio of entrance amplitude to mean water height on the upstream boundary. (Lang-USGS)
W70-03136

**CONTRIBUTIONS ON THE STATUS OF ARID-LANDS RESEARCH: GROUNDWATER IN AUSTRALIA,**
Arizona Univ., Tucson; and Army Natick Labs., Mass. Earth Sciences Div.
For primary bibliographic entry see Field 04B.
W70-03229

## 2G. Water in Soils

**SALINITY TOLERANCES OF CERTAIN TROPICAL SOILS AND RELATIONSHIPS BETWEEN SODIUM ION ACTIVITIES AND SOIL PHYSICAL PROPERTIES,**
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 03C.
W70-02848

**EVALUATION OF NUCLEAR METHODS OF DETERMINING SURFACE IN SITU SOIL WATER CONTENT AND DENSITY,**
Corps of Engineers, Vicksburg, Miss. Waterways Experiment Station.
For primary bibliographic entry see Field 07B.
W70-02876

**SOIL-WATER MOVEMENT IN RELATION TO MEASURED PHYSICAL PROPERTIES,**
California Univ., Davis. Dept. of Water Science and Engineering.
D. R. Nielsen.
Report available from Clearinghouse as AD-688 177, for $3.00 in paper copy, $0.65 in microfiche. US Army Electronics Command Technical Report Ecom-0034-F, Atmospheric Sciences Lab, July 1968. 77 p, 38 fig, 9 tab, 81 ref. Grant DAAB07-67-C-0034 Proj No IVO-14501-B53A-08.

Descriptors: *Soil water movement, *Soil physical properties, *Diffusivity, *Evapotranspiration, Soil moisture, Soil water, Percolation, Diffusion, Thermodynamics, Heat transfer, Mass transfer, Water balance, Evaporation, Infiltration, Unsaturated flow.
Identifiers: Soil water diffusivity.

A laboratory method was developed for calculating isothermal soil water diffusivity values for soils at 5 to 15 volume percent water. The redistribution of soil water within columns of Columbia fine sandy loam in response to imposed temperature gradients was analyzed. Transient water content distribution and soil temperature were recorded. Values of net water flux were examined in light of Fick's law, a diffusion theory proposed by Philip and de Vries, and an irreversible thermodynamic theory used by Taylor and Cary. Fick's law consistently underpredicted the observed water fluxes while the Philip-de Vries theory yielded acceptable values. Predictions of water flux based upon the Taylor-Cary theory were not acceptable. An intensive field investigation was conducted to measure and predict the soil temperature behavior during and following infiltration. A simplified mathematical model was used to predict temperature changes from the soil surface to a depth of 2 meters. The quantities of heat added by the infiltrating water were compared with the terms in the energy balance equation for that soil surface. Water balance measured at the soil surface allowed an estimate of the water moving past the root zone of an actively transpiring crop. (Knapp-USGS)
W70-02892

**CLAY MINERAL STABILITY AND WATER COMPOSITION,**
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05A.
W70-03026

**PREDICTION OF FLOW RESISTANCE IN FURROWS FROM SOIL ROUGHNESS,**
Colorado Agricultural Experiment Station, Ft. Collins.
For primary bibliographic entry see Field 03F.
W70-03221

**SOIL MOISTURE ON NATIVE GRAZING LANDS IN THE SEMIARID NORTHERN PLAINS OF USA,**
Agricultural Research Service; and Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 03F.
W70-03222

**RECENT ADVANCEMENTS IN THE USE OF STANDARD CLIMATIC DATA FOR ESTIMATING SOIL MOISTURE,**
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
W. Baier.
Annals of Arid Zone, Vol 6, No 1, p 1-21, Mar 1967. 22 p, 5 tab, 3 fig, 47 ref.

Descriptors: *Arid lands, *Soil moisture, *Soil-water-plant relationships, *Climatic data, *Water balance, Soils, Wheat, Droughts, Micrometeorology, Evapotranspiration, Computer models, Statistical methods, Moisture availability, Crop response, Evaporation, Electrical resistance.
Identifiers: *Canada, Electrical resistance blocks, Potential evaporation, Parameters.

There have been many studies of plant response to microclimatic parameters, but many of the parameters are not generally available and are difficult to measure. This paper reviews advances in technique to estimate soil moisture and crop response from standard climatic data which is widely available. This technique is of particular importance in arid and semiarid zones, where soil moisture is often the limiting factor. The author also discusses results of his statistical investigation of methods for estimating soil moisture and evaporation from standard climatic data. A versatile soil moisture budget (VB) technique is discussed which accounts for most of the requirements for earlier and generally more difficult meteorological budgeting methods. Using coefficients developed for several soil zones, correlation coefficients of .90 were obtained between soil moisture estimates using VB and soil moisture block readings. Daily soil moisture under wheat on a zone-by-zone basis was estimated by VB method and checked closely with measured soil moisture. VB generally provided good estimates even at different locations. Some discrepancies were noted in estimates for lower soil zones on days of peak water loss. This suggests that during drought plants are able to utilize available water in lower zones more efficiently than they do in periods of uniform moisture distribution. (Crouse-Arizona)
W70-03233

## 2H. Lakes

**MAGADIITE FROM ALKALI LAKE, OREGON,**
Air Force Cambridge Research Center, Bedford, Mass.; Geological Survey, Washington, D.C.; and Air Force Academy, United States Air Force Academy, Colo.
Thomas P. Rooney, Blair F. Jones, and James T. Neal.
The American Mineralogist, Vol 54, p 1034-1043, July-Aug 1969. 10 p, 4 fig, 2 tab, 12 ref.

Descriptors: *Water chemistry, *Chemical precipitation, *Sodium compounds, *Silicates, *Playas, *Oregon, Mud, Geology, Mineralogy, Aqueous solutions, Brines, Mud flats.
Identifiers: Magadiite, Alkali Lake (Ore).

Magadiite (a hydrous sodium silicate) has been identified in veins cutting playa sediments and in muds associated with alkali salts and brines at Alkali Lake playa, Oregon. Magadiite has apparently precipitated directly from solution, perhaps as a result of pH changes on dilution by runoff. The magadiite veins may be related to syneresis cracking in very fine-grained playa sediments derived from acid volcanics. (Knapp-USGS)
W70-02856

**PRELIMINARY OBSERVATIONS UPON THE FERTILIZATION OF CRECY LAKE, NEW BRUNSWICK,**
Atlantic Biological Station, St. Andrews (New Brunswick).
M. W. Smith.
Transactions of the American Fisheries Society, Vol 75, p 165-174, 1945. 1 fig, 1 tab, 14 ref.

Descriptors: *Fertilization, *Nitrogen, *Phosphorus, *Potassium, Hydrogen ion concentration, Fish, Lakes, Productivity, Brook trout, Shallow water, Sampling.
Identifiers: New Brunswick, Nova Scotia, Infertile waters, Enrichment, Ammonium phosphate, Potassium chloride, Bottom fauna, Microcrustacea, Crecy Lake (N B Canada), Salvelinus fontinalis, Anabaena blooms.

Addition of one ton of mono-ammonium phosphate and 500 pounds of potassium chloride to infertile 20-hectare lake increased the planktonic biomass and benthic organisms, largely Hyalella. The development of a heavy bloom of Anabaena appeared to have a deleterious effect on microcrustaceans. The soluble fraction of the introduced phosphate was rapidly decreased by biofixation from about 0.4 parts per million to 0.03 parts per million. (Wilde-Wisconsin)
W70-02974

**COMPOSITION AND HORIZONTAL DISTRIBUTION OF CRUSTACEAN PLANKTON IN LAKE ONTARIO,**
Fisheries Research Board of Canada, Winnipeg (Manitoba). Freshwater Inst.
K. Patalas.
Journal Fisheries Research Board of Canada, Vol 26, No 8, p 2135-2164, 1969. 23 fig, 1 tab, 23 ref.

Descriptors: *Distribution patterns, *Lake Ontario, *Plankton, Daphnia, Sampling, Crustaceans, Copepods.
Identifiers: *Horizontal distribution, *Crustacean plankton, Bosmina, Cyclops, Ceriodaphnia, Tropocyclops, Vertical distribution, Sampling stations, Cladocera.

Distribution of zooplankton was ascertained through collections from June-October 1967 as part of an effort to characterize the biological communities of the Great Lakes relative to natural and cultural eutrophication processes. Eleven species of copepods and cladocerans were found; most abundant forms being species of Cyclops, Daphnia, Bosmina, Tropocyclops, and Ceriodaphnia. Bosmina longirostris and Cyclops bicuspidatus were most abundant cladocerans and copepods, respectively, in summer plankton. Most species appeared in June-July at eastern end of lake, zones of abundance later expanding westward. In September, some species (Bosmina, Ceriodaphnia) occurred mainly in western end, disappearing from the east. Others (Daphnia, Cyclops) were distributed over entire lake, inclined to concentrate in offshore regions. In October, most species had decreased in western end with a slight increase in abundance in the eastern end, tending to a more uniform lakewide distribution. Total plankton concentration was highly correlated (coefficient of correlation, $r = 0.80$, degrees of freedom approximately 13) with heat content (kilocalories/square centimeter) of water. Thermal structure of lake is wind-generated. Graphical data include seasonal distribution maps of dominant zooplankters, and

detailed study of effects of Toronto Harbor on localized zooplankton populations. (Voigtlander-Wisconsin)
W70-02975

**WATER QUALITY STUDIES ON THE GREAT LAKES BASED ON CARBON FOURTEEN MEASUREMENTS ON PRIMARY PRODUCTIVITY,**
Minnesota Univ., Minneapolis.
William G. Parkos, Theodore A. Olson, and Theron O. Odlaug.
Water Resources Research Center, Minnesota Univ Graduate School, Minneapolis, WRRC Bulletin 17, 1969. 121 p, 23 fig, 25 tab, 70 ref, 10 plates, appendix A, B, C, D, E, F. OWRR Project A 011-MINN.

Descriptors: *Primary productivity, Surface waters, Productivity, Phytoplankton, Great Lakes, Lake Superior, Lake Michigan, Lake Huron, Lake Erie, Water quality.
Identifiers: Carbon-14 measurement, Shipboard incubation.

Carbon-14 measurements of surface water primary production of Lakes Superior, Michigan, Huron, and Erie are reported. Estimates are based on shipboard incubation of samples collected at irregular intervals during the 1967 and 1968 shipping seasons. Lake Superior proved to be the least productive of the lakes studied, mean surface productivity of 16.72 milligrams of carbon/cubic meter per day. The other lakes showed increasing levels of productivity: Lake Huron, 23.04 milligrams of carbon/cubic meter per day, Lake Michigan, 37.62 milligrams of carbon/cubic meter per day, and Lake Erie, 175.20 milligrams of carbon/cubic meter per day. Highest productivity levels in each lake tended to occur near large population centers. (Koonce-Wisconsin)
W70-02983

**EFFECTS OF THERMAL STRATIFICATION UPON OXYGEN RESOURCES - JOHN H. KERR RESERVOIR,**
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-03070

**HYDROLOGY OF SMALL WATER AREAS IN THE PRAIRIE POTHOLE REGION,**
Geological Survey, Washington, D.C.
W. S. Eisenlohr, Jr.
Canadian Wildlife Service Report Series, No 6, Saskatoon Wetlands Seminar, p 35-39, 1969. 5 p, 2 fig, 2 ref.

Descriptors: *Water balance, *Hydrologic budget, *Lakes, *Ponds, *Playas, Water chemistry, Water quality, Inflow, Evapotranspiration, Limnology, Water levels, Vegetation effects, Sedimentation.
Identifiers: Saskatchewan, Prairie potholes.

The hydrology of prairie potholes is briefly reviewed in a paper presented in a wetlands seminar. Potholes, usually shallow ephemeral lakes, are filled by rainfall on the surface of the lake, seepage, and surface inflow, and empty by seepage, evaporation, and surface outflow. When the soil is frozen it is impermeable and basin inflow takes place easily. If snow melts gradually, much of the water can evaporate. If snow melts after the ground thaws, water can seep into the ground. These conditional effects on the melting of snow can obliterate and even reverse the effects of total seasonal or annual precipitation. Basin inflow will occur only when rain falls on frozen or saturated soil, or at a greater rate than the maximum infiltration capacity of the soil. Soil moisture and to some extent the magnitude of a storm, are the effective controls over the amount of precipitation that becomes basin inflow, and that annual precipitation is meaningless as a measure of water replenishment in a slough. Vegetation affects water loss from a pothole in two ways: (1) it reduces the loss from evaporation by sheltering the water surface from incoming radiation, and (2) it may increase the loss by the amount of water is transpires. Evaporation makes the contents of a slough more saline than the inflow. Overflow, through periodic flushing, may well keep dissolved solids in many potholes from becoming very concentrated. (Knapp-USGS)
W70-03081

**THE LIMNOLOGY OF ONEIDA LAKE - AN INTERIM REPORT,**
Geological Survey, Albany, N.Y.
Phillip E. Greeson, and George S. Meyers.
New York Water Resources Commission Report of Investigation RI-8, 1969. 64 p, 23 fig, 13 tab, 53 ref.

Descriptors: *Limnology, *New York, *Eutrophication, *Algae, Water quality, *Nutrients, Waves (Water), Seiches, Water pollution effects, Water pollution sources, Runoff, Agricultural chemicals, Nitrates, Phosphates, Water chemistry.
Identifiers: *Oneida Lake (N Y).

The general concepts of lake eutrophication are discussed and the findings of the first year of field investigations on the eutrophication of Oneida Lake, New York are presented. Routine biological and chemical data revealed that the lake has become eutrophic both through the natural processes of lake aging and from the inflow of nutrient-rich water from the fertile drainage basin. The four most important factors affecting the biological activities within the lake are: (1) the high fertility of the drainage basin, (2) the physical position and shallowness of the lake, (3) mixing of the water by wind action, and (4) the inclusion of bottom sediments in the recycling of nutrient materials. (Knapp-USGS)
W70-03101

**COMPUTATION OF RESERVOIR SEDIMENTATION WITH SUSPENDED LOAD (CZECH),**
For primary bibliographic entry see Field 02J.
W70-03118

**LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.**
Illinois State Sanitary Water Board, Springfield.
For primary bibliographic entry see Field 05A.
W70-03140

## 2I. Water in Plants

**LICHENOMETRY TO EVALUATE CHANGES IN GLACIAL MASS BUDGETS: AS ILLUSTRATED FROM NORTH-CENTRAL BAFFIN ISLAND, N.W.T.,**
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Sciences.
J. T. Andrews, and P. J. Webber.
Arctic and Alpine Research, Vol 1, No 3, p 181-194, Summer 1969. 14 p, 9 fig, 1 tab, 24 ref.

Descriptors: *Lichens, *Glaciation, *Glaciers, *Arctic, Ice, Sampling, Ablation, History, Mapping, Radioactive dating, Geomorphology, Geology.
Identifiers: *Canada, Baffin Island, *Lichenometry.

Direct measurement of the growth of Alectoria minuscula over 4.3 growing seasons enables a further assessment to be made on the value of lichenometry around the Barnes Ice Cap. Detailed lichen sampling in two formerly glacierized valleys allows isophyses to be drawn for specific diameters of A. minuscula. The gradients of the isophyses are similar to those of lateral glacial features. These reconstructions define ice margins from about 1650 A.D. to the present time and enable glacier changes in length, area, and volume to be estimated for the Lewis and Pintail glaciers. Local differences in the trend of area or volume loss are explained by differences in deglacial history. Specific ablation for the expanded Lewis Glacier below the 500 m ice contour averaged about 1.5 m ice equivalent per year, a value not dissimilar to those determined on the present glacier of about 1.3 m ice equivalent. Sampling over extended distances on substrates of similar age around the Barnes Ice Cap indicates comparable maximum lichen diameters are present. The value of lichenometry in arctic areas is reaffirmed. (Gabriel-USGS)
W70-02873

**DROUGHT HAZARDS TO SEED GERMINATION,**
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 03F.
W70-03234

**THE CONTROL OF SEED GERMINATION BY WATER-RELATIONS,**
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
Dov Koller.
Annals of Arid Zone, Vol 6, No 1, p 35-41, Mar 1967. 3 tab, 21 ref.

Descriptors: *Germination, *Seeds, *Soil-water-plant relationships, *Soil moisture, *Inhibitors, Plant physiology, Arid lands, Seed treatment, Moisture availability, Impermeability, Humidity, Air environment, Soil environment, Environment, Vegetation establishment, Permeability.
Identifiers: *Water potential, *Plant survival.

Seeds may come in contact with water under many conditions which are unsuitable for germination and survival. Plants have evolved germination-regulating mechanisms to insure success of the species. The author draws on data of his own and information already in the literature to review and summarize germination-regulating mechanisms actuated by water-relations. Many seeds contain water-soluble inhibitors which leach out of the seed coating only after enough water has flowed past the seed into the soil to assure sufficient moisture availability for successful plant establishment. Some seeds have water-impermeable coasts which become permeable only after exposure to relatively humid conditions for some time period. In arid lands this tends to limit possibility of germination to that season of the year favorable to plant establishment. Seeds of some species are inhibited from germination even in the presence of adequate soil moisture if the water potential is not appropriate for seedling survival. Presence of liquid water in contact with the seed is not sufficient for germination. Atmospheric humidity, cycles of wetting and drying, volume of water passing into the soil and water potential of the medium may all have significant effects on germination. In arid lands or areas subject to periods of drought these mechanisms may be important to survival potential of the species. (Crouse-Arizona)
W70-03235

**THE ROOT GENERATING CAPACITY OF SEEDLING TRANSPLANTS AND THE AVAILABILITY OF SOIL MOISTURE,**
California Univ., Berkeley.
Edward C. Stone.
Annals of Arid Zone, Vol 6, No 1, p 42-57, Mar 1967. 9 fig, 11 ref.

Descriptors: *Arid lands, *Ponderosa pine trees, *Root development, *Planting management, *Moisture availability, Moisture stress, Soil-water-plant relationships, Semiarid climates, Plant growth, Field capacity, Soil environment, Timing, Temperature, Forestry, Forest Management, Coniferous trees, Plant physiology.
Identifiers: *Seedlings, *Plant survival.

Survival of forest tree seedlings planted in arid or semiarid climates is highly dependent on root

growth during the first growing season after planting. In the case of bare root seedlings, new root growth is strongly dependent on available soil moisture and physiological potential of the plant to grow new roots rapidly. The author tested several conifer species but found that only one, Pinus ponderosa Laws. (Ponderosa pine) seemed to have potential for survival under arid conditions. This paper presents a summary of recent literature on root growth potential of bare-root nursery stock and the author's own research into the root regenerating potential (RRP) of ponderosa pine. Since it is not always possible in arid and semiarid lands to plant when the soils are at or near field capacity, the author conducted studies of the RRP of ponderosa pine in soil at 100, 50, and 20% initial available soil moisture. A simple assessment technique is presented for determining effects of nursery location and cultural practices of the RRP of seedlings. It should also be possible to estimate survival rate of seedlings at various planting sites if soil moisture and temperature sequences of the site are known. By establishment of nurseries at different locations it should be possible to produce seedlings with a high RRP for planting at different times. (Crouse-Arizona)
W70-03236

**WATER MOVEMENT IN INJECTED TREES,**
Bartlett Tree Research Labs., Stamford, Conn.
Johnson Parker.
Annals of Arid Zone, Vol 6, No 1, p 58-65, Mar 1967. 4 tab, 7 ref.

Descriptors: *Droughts, *Absorption, *Deciduous trees, *Plant physiology, *Translocation, Plant diseases, Nutrients, Dye releases, Tracers.
Identifiers: *Plant water movement.

Drought with resulting soil moisture stress is thought to be a cause of several diseases of broad-leafed deciduous trees. The author reports a study of the movement of water injected into trees as one step toward better understanding of this procedure. Distilled water was injected into 6 species: white oak, beech, red maple, red oak, American elm, and ash. Different species absorbed substantially different amounts of water although the amount varied widely among different trees of the same species and on the same tree on different days. Dyed water moved both up and down but tended to remain in a narrow path in the ring porous species, while in diffuse porous species it spread laterally about one inch for each foot of travel. Addition of any dissolved substance, even nutrient solutions, caused a sharp drop in the rate of water uptake. (Crouse-Arizona)
W70-03237

**INTERRELATIONSHIP OF HABITAT TO GROWTH AND COMPOSITION OF ZIZYPHUS NUMMULARIA,**
Central Arid Zone Research Inst., Jodhpur (India).
P. C. Nanda.
Annals of Arid Zone, Vol 6, No 1, p 66-73, Mar 1967. 4 tab, 2 ref.

Descriptors: *Arid lands, *Plant morphology, *Soil moisture, *Storage capacity, *Soil-water-plant relationships, Environmental effects, Moisture stress, Plant growth, Moisture availability, Soil types, Leaves, Water storage, Sands, Soil environment, Seasonal, Variability, Moisture content.
Identifiers: *India, Fruits, Rocky soils.

In arid lands available soil moisture becomes very low during long periods without precipitation. Plants are therefore growing under conditions of moisture stress. The author studied effects of moistures stress on the native species Zizyphus Nummularia on both deep sandy soil and a shallow rocky soil. The rocky soil had a higher moisture content during the rainy season, but because of greater total storage capacity, the sandy soil had more reserve moisture during long dry seasons. Plants on the sandy soil had less moisture content in leaves and smaller fruits. The sandy site plants put on new leaves and smaller fruits. The sandy site plants put on new leaves and developed flower buds two months earlier than plants on the rocky site. Plants on the sandy site retained leaves throughout the year whereas plants on the rocky soil dropped all leaves during the later months of the dry season. In general plants on sandy soils grew longer and faster than those on the rocky soil. There were distinct morphological differences between the same species grown on the two soil types. (Crouse-Arizona)
W70-03238

**COMPARATIVE PLANT WATER RELATIONS,**
Aberdeen Univ. (Scotland). Dept. of Botany.
For primary bibliographic entry see Field 02D.
W70-03239

## 2J. Erosion and Sedimentation

**PRESENT RATE OF LAND EROSION,**
University of East Anglia, Norwich (England). School of Environmental Sciences.
Anthony Young.
Nature, Vol 224, No 5222, p 851-852, Nov 29, 1969. 2 p, 2 fig, 41 ref.

Descriptors: *Erosion, *Geomorphology, *Land forming, Sediment load, Slopes, Topography, Cultivated lands, Sediment yield.
Identifiers: *Erosion rates.

Available estimates of the average worldwide erosion rate are reviewed. If results are divided into normal and steep relief groups, a clear difference in rates appears; normal or gentle slopes erode about 46 mm/1000 yr and steep slopes erode about 500 mm/1000 yr. These results are comparable with estimates based on sediment loads in streams. Agricultural land erosion is somewhat faster than the erosion of uncultivated land and this must be taken into account in estimating erosion rates in most areas. (Knapp-USGS)
W70-02860

**GEOLOGICAL SIGNIFICANCE OF NORTH SEA SAND TRANSPORT RATES,**
National Inst. of Oceanography, Wormley (England).
For primary bibliographic entry see Field 02L.
W70-02864

**SEDIMENT TRANSPORT BY STREAMS IN THE WALLA WALLA RIVER BASIN, WASHINGTON AND OREGON, JULY 1962 - JUNE 1965,**
Geological Survey, Washington, D.C.
B. E. Mapes.
Report available from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price 60 cents (paper copy). Geological Survey Water-Supply Paper 1868, 1969. 32 p, 7 fig, 1 plate, 7 tab, 18 ref.

Descriptors: *Sediment transport, *Washington, *Bed load, *Suspended load, Sediment yield, Provenance, Sediments, Alluvium, Particle size, Sands, Silts, Clays, Data collections, Hydrologic data, Streamflow, Geology, Topography, Climates.
Identifiers: *Walla Walla River basin (Wash-Ore).

The Walla Walla River basin covers about 1,750 square miles in southeastern Washington and northeastern Oregon. The mountainous eastern part of the basin is underlain at shallow depth by basalt which has a residual soil mantle. The slopes are characterized by alluvial fans and deeply cut stream valleys filled with sand, gravel, and cobbles. Average annual sediment yields ranged from 420 tons per sq mi in the mountainous area to more than 4,000 tons per sq mi in the extensively cultivated northern and central parts. The highest concentrations were contributed by the loessal deposits in the Dry Creek drainage. Two runoff events resulting from rain and snowmelt on partially frozen ground produced 76% of suspended sediment discharged. Daily suspended-sediment concentrations for the Walla Walla River near Touchet exceeded 700 mg/l about 10% of the time, and 14,000 mg/l about 1% of the time. The mean concentration was 7,000 mg/l. Silt predominates in the suspended sediment. The bedload in the mountain and upland streams was about 5-12% as much as the suspended load. In the lower basin area, the bedload was about 2-8% as much as the suspended load. (Knapp-USGS)
W70-02879

**RESPONSE OF A LABORATORY ALLUVIAL CHANNEL TO CHANGES OF HYDRAULIC AND SEDIMENT-TRANSPORT VARIABLES,**
Geological Survey, Washington, D.C.
R. E. Rathbun, H. P. Guy, and E. V. Richardson.
Report available for sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.40 (paper cover). Geological Survey Professional Paper 562-D, p D1-D32, 1969. 32 p, 21 fig, 4 tab, 24 ref.

Descriptors: *Sediment transport, *Bed load, *Model studies, *Hydraulic models, *Flumes, Equipment, Instrumentation, Research and development, Calibrations, Sands, Sediments, Laboratory tests, Pumps.
Identifiers: *Sedimentation flumes, Recirculating flumes, Sediment-feed flumes.

The feed and recirculation systems of experimental sediment-transport flume operation were compared in a series of experiments conducted in a tilting plastic flume 10 meters long, 20 centimeters deep, and 20 centimeters wide. No significant differences were observed in the mean values of the sediment-transport rate, water-surface slope, depth of flow, and mean velocity for the two systems in the equilibrium steady state. The responses of the laboratory alluvial channel with a constant water discharge to changes of sand-bed slope, tail-water depth, and sediment-transport rate were determined. The recirculation system has the advantage of ease and economy of operation, and the feed system has the advantage of direct quantitative control of the sediment-transport rate. (Knapp-USGS)
W70-02880

**RESULTS OF THE STUDY OF SUSPENDED LOAD RUNOFF OF THE RIVERS OF ROMANIA (FRENCH),**
C. Diaconu.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 51-89, Sept 1969. 39 p, 3 fig, 15 tab, 5 ref, 2 append.

Descriptors: *Suspended load, *Runoff, *Rivers, *River flow, Hydrologic data, Sampling, Turbidity, Hydrologic properties, River basins, Statistical methods, Probability, Floods, Mapping, Erosion, Discharge measurement.
Identifiers: *Romania.

The methods and the results obtained during the 1951-1967 period for the determination of water discharge, turbidity, and suspended load of the rivers of Romania are described. The recorded data given as the annual, monthly, and discreet values show that in the interior rivers of Romania the maximum river discharge is much greater than 1.25 times the mean annual discharge. (Gabriel-USGS)
W70-02885

**SUSPENDED LOAD TRANSPORT BY STREAMFLOWS (FRENCH),**
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
F. Fournier.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 7-49, Sept 1969. 43 p, 5 tab.

Descriptors: *Suspended load, *Sediment transport, *Streamflow, Sediments, Erosion, Deposition (Sediments), Hydrologic data, Rivers, Estuaries, Climates, Gaging stations, River basins, Tropical regions, Subtropic, International Hydrological Decade.
Identifiers: *World rivers, World sedimentation rates.

A detailed study was made of the suspended load transported by the rivers of the world on the basis of data recorded at 140 gaging stations located at 107 rivers prior to 1967. The data are arranged in tables in accordance with gaging station locations, watershed discharge areas, climatic conditions, and monthly transports of suspended load. (Gabriel-USGS)
W70-02886

**THE NORTH BOSQUE WATERSHED INVENTORY OF A DRAINAGE BASIN,**
Baylor Univ., Waco, Tex. Dept. of Geology.
For primary bibliographic entry see Field 02E.
W70-03077

**STANDARDIZATION OF PARTICLE-SIZE RANGES.**
American Society of Civil Engineers, New York.

ASCE Proceedings, Journal of the Soil Mechanics and Foundations Division, Vol 95, No SM5, Paper 6795, p 1247-1252, Sept 1969. 6 p, 3 ref.

Descriptors: *Particle size, *Sediments, *Standards, Materials, Materials testing, Clays, Sands, Silts, Sedimentology.
Identifiers: Particle size standards.

A committee was formed of members of several scientific and technical societies to recommend particle size standards acceptable for the common use of their members. After considering the positions of the participating societies, the Intersociety Committee reached agreement on a joint statement regarding the status of grain-size classes for sand, silt, and clay. The upper size limits in mm of clay, silt and sand fractions now in common use are as follows: clay = 0.002, 0.0039, and 0.005; silt = 0.05 (No 270 sieve), 0.0625 (No. 230 sieve), and 0.074 (No. 200 sieve); sand = 2.0 (No. 10 sieve) and 4.76 (No. 4 sieve). The prospects of attaining agreement on the upper size limits of clay seems good and we recommend the 0.002 mm limit. The possibilities of attaining agreement on the upper size limit of silt are slight to moderate, 0.0625 mm and 0.074 mm seem reasonable alternatives, with slight preference for the 0.074 limit. The prospect of attaining agreement on the upper sand size limit seems moderate to good and the 2.0 mm limit is recommended. (Knapp-USGS)
W70-03093

**SEDIMENTATION IN UPPER STONY CREEK BASIN, EASTERN FLANK OF THE COAST RANGES OF NORTHERN CALIFORNIA,**
Geological Survey, Washington, D.C.
J. M. Knott, and C. A. Dunnam.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.25 for paper copy. Geological Survey Water-Supply Paper 1798-F, p F1-F35, 1969. 35 p, 11 fig, 9 tab, 20 ref.

Descriptors: *Sedimentation, *Small watersheds, *Reservoir silting, *California, Suspended load, Bed load, Sediment transport, Streamflow, Storm runoff, Stream erosion, Sediment yield.
Identifiers: Coast Ranges (Calif).

Sediment surveys in 1960 and 1962 indicated that the average annual rate of accumulation in East Park Reservoir, California during the period 1910-62 was 0.37 acre-ft per sq mi of drainage area and that in Stony Gorge Reservoir during the period 1928-62 it was 0.27 avre-ft per sq mi. Maximum deposition occurred in the deeper parts of the reservoirs along prereservoir stream channels. Storage capacity of both reservoirs has been depleted approximately 0.1% per year by sediment deposition. Estimates of suspended-sediment discharge were made from periodic measurements on Stony Creek at Black Butte Dam. Annual sediment yield at this site averaged 0.93 acre-ft per sq mi during the 6-year period 1957-62. Most of the sediment load of Stony Creek and its tributaries is transported during periods of storm runoff. The sediment is predominantly of silt and clay size (less than 0.062 mm). Bedload discharge is a minor part of the Stony Creek sediment discharge. The bedload, as computed by 3 procedures (Einstein, Meyer-Peter and Muller, and Schoklitsch), was 1-6% of the suspended load. (Knapp-USGS)
W70-03099

**HYDROMORPHOLOGICAL PRINCIPLES OF COMPUTATIONS OF FREE MEANDERING: 1. SIGNS AND INDEXES OF FREE MEANDERING,**
N. Ye. Kondrat'yev.
Trans from Trudy GGI, No 155, p 5-38. Soviet Hydrology: Selected Papers, No 4, p 309-335, 1968. 23 fig, 5 tab, 10 ref.

Descriptors: *Channel morphology, *Meanders, Rivers, Equations, Channels, River flow, Sediment transport, Stream erosion, Alluvial channels, Sedimentary structures.
Identifiers: USSR, Channel geometry.

Four major topics dealing with free meandering are quantitatively treated. These topics are: (1) Signs and indexes of free meandering; (2) horizontal deformation of meanders during free meandering; (3) structure of the velocity field of flow in a meander of a river; and (4) computations of the deformations of a meander in free meandering. The following methods of computations are presented: (1) Computation of horizontal deformations; (2) formula for constructing the axial line of channel; (3) computation of the horizontal position of a pool hollow by Garbrecht's method; and (4) computation of the pool hollow in a single-pool meander. These methods are compared and their advantages and limitations are discussed. (Carstea-USGS)
W70-03107

**DISCHARGE OF SUSPENDED SEDIMENTS IN THE DON RIVER,**
V. V. Krayushin.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 144-151, 1968. Soviet Hydrology: Selected Papers, No 4, p 400-407, 1968. 3 fig, 7 tab, 9 ref.

Descriptors: *Sediments, *Sediment transport, Rivers, Reservoirs, Sediment discharge, Hydraulic structures, Discharge (Water), River flow, Trap efficiency, Silting, Reservoir silting.
Identifiers: *USSR, Don River, Tsimlyansk Reservoir.

The channel formation process and the operating conditions of many hydraulic installations are affected by the magnitude and regime of sediment discharge. Discharge of suspended sediment in the Don River is examined under a natural regime and with the Tsimlyansk Reservoir as a sediment accumulator. Although the suspended sediment discharge depends mainly on water discharge, there is no strict proportionality between these two parameters. The Tsimlyansk Reservoir is essentially a sediment trap for the upper, middle, and lower Don. The computations show that about 17 to 82% of the annual discharge of suspended sediments is lost at the present time in the Tsimlyansk Reservoir. (Carstea-USGS)
W70-03111

**COMPUTATION OF RESERVOIR SEDIMENTATION WITH SUSPENDED LOAD (CZECH),**
Jaroslav Sumbal.
English summary. Vyskumny Ustav Vodneho Hospodarstva, Bratislava, Prace a studie 51, 1968. 65 p, 19 fig, 6 tab, 15 ref.

Descriptors: *Reservoir silting, *Sedimentation, *Suspended load, *Mathematical studies, Forecasting, Water levels, Analog computers, Discharge (Water), Mapping, Hydraulic models.
Identifiers: Reservoir sedimentation.

Reservoir silting is analytically investigated on the basis of G. I. Samov's method (1954). The computation of silting is based on the assumption that the fall velocity of the suspended load particles in turbulent flows can be expressed mathematically as a function of some critical velocity. The solution of final equations derived by using this technique, by nomograms, numerically, and by analog computer yields probable heights and spatial distribution of sediments in water reservoirs. (Gabriel-USGS)
W70-03118

## 2K. Chemical Processes

**ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,**
Michigan State Univ., East Lansing. Coll. of Engineering.
For primary bibliographic entry see Field 05B.
W70-02843

**OCCURRENCE AND DISTRIBUTION OF MOLYBDENUM IN THE SURFACE WATER OF COLORADO,**
Geological Survey, Washington, D.C.
Paul T. Voegeli, Sr., and Robert U. King.
Geol Surv Water-Supply Paper 1535-N, p N1-N32, 1969. 32 p, 1 fig, 1 plate, 3 tab, 7 ref.

Descriptors: *Water chemistry, *Trace elements, *Molybdenum, *Colorado, Data collections, Hydrologic data, Sampling, Surveys, Exploration, Mining, Water quality, Geochemistry.
Identifiers: Geochemical prospecting.

Molybdenum was detected in 89% of the samples collected from all the principal Colorado streams and their chief tributaries and from a few reservoirs and lakes. Amounts detected ranged from 1 to 3,800 micrograms per liter. The greatest amounts of molybdenum detected were in samples from the Colorado River at and below Kremmling, the Dillon Reservoir, the Blue River below Kremmling, the Dillon Reservoir, the Blue River below Dillon Dam, the Eagle River, and Tenmile Creek. (Knapp-USGS)
W70-02878

**NITROGEN FIXATION ASSESSMENT BY ACETYLENE REDUCTION,**
Oregon State Univ., Corvallis.
Robert V. Klucas.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 109-116. 2 tab, 30 ref.

Descriptors: *Nitrogen fixation, *Assay, Eutrophication, Aquatic environment, Microorganisms, Enzymes, Ammonia, Radioisotopes, Bacteria, Cyanophyceae, Lichens, Clostridium, Azotobacter.
Identifiers: *Acetylene reduction, Free-living systems, Ethylene, Symbiotic systems, Root nodules, Root-associated, Rhodospirillum rubrum, Anabaena cylindrica, Anabaena flos-aquae, Calothrix, Gloeotrichia echinulata, Nostoc entophytum, Nostoc muscorum, Mastigocladus laminosus, Tolypothrix tenuis, Glycine max, Myrica cerifera, Phaseolus vulgaris, Medicago sativa, Arachis hypogea, Pisum sativum, Comptonia peregrina, Alnus rugosa, Cycas revoluta, Zamia floridana, Collema, Peltigera, Pseudocyhel-

laria, Clostridium pasteurianum, Azotobacter Chroococcum, Azotobacter vinelandii.

Biological nitrogen fixation is the enzymic conversion of molecular nitrogen to ammonia. Growth on nitrogen-free medium has been used for screening for nitrogen fixing agents, but this method lacks sensitivity and requires extended investigative periods. The nitrogen-fixing complex reducing acetylene to ethylene is the basis for a new and sensitive assay for nitrogen fixation. The procedure exposes the organism to be tested to acetylene, incubating and analyzing the gas phase for ethylene. Of numerous methods used to measure ethylene, one especially sensitive method is by hydrogen-gas flame ionization gas chromatography. Evidence suggests that acetylene is reduced by nitrogenase. Acetylene reduction assay for nitrogen fixation has been used successfully with a number of free-living and symbiotic systems. The simplicity, sensitivity, and rapidity of the method is particularly adaptable to field investigations where numerous samples must be analyzed. One aspect of eutrophication is the nitrogen input into the aquatic environment; although many sources contribute to nitrogen increase, in situ fixation by microorganisms certainly is involved in this input. With the acetylene reduction assay, a simple and sensitive method is available for ascertaining the amount of nitrogen fixation in aquatic ecosystems. (See Vol 3, No 7, entry W70-02775). (Jones-Wisconsin)
W70-02963

**CLAY MINERAL STABILITY AND WATER COMPOSITION,**
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05A.
W70-03026

**GEOCHEMISTRY AND HYDROLOGY OF A SMALL BASIN IN THE UPPER BUFFALO RIVER WATERSHED, TENNESSEE,**
Vanderbilt Univ., Nashville, Tenn., and Tennessee Div. of Water Resources, Nashville.
Richard G. Stearns, and John M. Wilson.
Interim Report, Tennessee Water Resources Research Institute, 1969. 3 p. OWRR Project A-011-TENN.

Descriptors: *Geochemistry, *Small Basin, *Hydrology, Rainwater, Groundwater, Surface Water, Weathering, *Leaching, *Precipitation, *Cherty Limestone, Soil, Residuum.

Passing through soil, rainwater pH drops 7 to 5 ($CO_2$ added); silica increases from 1 to 5 ppm, and calcium decreases from over 10 to less than 1 ppm. (Source of 'fallout' calcium is a mystery.) Groundwater regains calcium (to 50 or more ppm) and picks up more silica (to nearly 10 ppm) in the residuum. The surface stream is low in hardness (7 ppm) and pH (about 6) until it intersects permanent springs where it gains calcium (to 40 ppm) and pH increases (to about 7), as it mixed with groundwater that had been in contact with bedrock. Iron appears to be depositing at 4 pounds per acre per year. Silica appears to be carried away at 30 pounds per acre per year, and calcium at 8 pounds. Bedrock consists mainly of the minerals quartz, calcite and dolomite (cherty dolomitic limestone). Soil and residuum are impoverished in all but quartz, and there is an abrupt contact with a chert layer on bedrock. Groundwater percolates down to the top of rock where it moves laterally. Chert layers at least partially protect bedrock calcite from solution.
W70-03036

**CHEMICAL QUALITY OF WATER IN NORTHERN NIGERIA, 1965-1968,**
Geological Survey, Kaduna (Nigeria).
Raymond T. Kiser.
Geol Surv Open-file Report, Dec 1968. 41 p, 1 fig, 6 tab, 7 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Water quality, Streamflow, Water wells, Springs, Water yield, Water utilization, Stock water, Domestic water, Irrigation water, Hydrologic data, Data collections.
Identifiers: *Nigeria.

More than 300 complete chemical analyses of water samples were collected during the period July 1965 to August 1968 from widespread sources in northern Nigeria. Most of the samples were obtained from groundwater sources, lakes, ponds, and streams in the Chad, West Chad, and Sokoto basins, Kerri Kerri area, Kaduna-Zaria area, and other scattered localities. The waters vary widely in dissolved solids concentration and chemical type, but most sources are suitable for livestock and man. Nearly half the water samples, however, from dug wells in West Chad basin and Kerri Kerri area have high nitrate, and many water sources from boreholes (drilled wells) in Chad and Sokoto basins have undesirable amounts of iron or manganese. Some groundwater sources, particularly in the Chad basin, are limited in their suitability for irrigation use because of salinity, sodium, or bicarbonate hazards. (Knapp-USGS)
W70-03072

**SUMMARY OF WATER QUALITY STANDARDS FOR THE INTERSTATE WATERS OF ARKANSAS.**
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-03083

**DISCHARGE OF DISPERSED AND RARE ELEMENTS (MICROELEMENTS) IN SOLUTION AND IN SUSPENDED SUBSTANCES FROM THE TERRITORY OF THE USSR,**
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
A. A. Ivanova, and G. S. Konovalov.
Transl from Gidrokhimicheskiye Materialy, Vol 44, p 63-82, 1968. Soviet Hydrology: Selected Papers, No 4, p 336-353, 1968. 1 fig, 1 tab, 9 ref.

Descriptors: *Trace elements, *Water chemistry, *Water quality, Rivers, Watersheds (Basins), Cobalt radioisotopes, Copper, Molybdenum, Sediments, Manganese, Geochemistry.
Identifiers: *USSR, Silver, Vanadium, Nickel, Lead, Zinc.

Mechanical, physical, chemical, and biological processes taking place in a hydrographic basin are usually reflected in the amount of microelements removed from the land. The magnitude of the removal is also determined by the chemical properties of the elements themselves. Mountain rivers remove most of the microelements in suspension. In contrast, lowland rivers frequently remove microelements in solution. The USSR discharge of vanadium, manganese, cobalt, nickel, copper, zinc, lead, silver, and molybdenum is computed. The total amount of these elements which are removed into the sea is approximately 1,096,000 tons/year. Only one-fifth of this amount is removed in solution. (Carstea-USGS)
W70-03108

**HYDROCHEMICAL STUDY OF ATMOSPHERIC PRECIPITATION,**
P. P. Voronkov.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 67-81, 1968. Soviet Hydrology: Selected Papers, No 4, p 381-392, 1968. 6 tab, 14 ref.

Descriptors: *Water chemistry, *Water quality, *Precipitation (Atmospheric), Dust storms, Soils, Agricultural watersheds, Forest soils, Soil chemical properties, Snow cover.
Identifiers: *USSR, Kazakhstan, Altai.

The chemical composition of precipitation can change very rapidly in the southern regions of the USSR. In contrast, precipitation retains its characteristic chemical features for a long time in the northern regions. The upper soil layer can become a source of pollution of the air layer near the ground, as illustrated by observations in one of the lowland regions of the Altai. Significant differences were measured in the chemical composition of field and forest snow, and were attributed to soil dust. The snow water from the field had a much higher content of bicarbonate, Ca, and pH than the snow from forested land. Differences in the chemical composition of water obtained from the upper and lower snow layers are discussed for the steppe regions of Kazakhstan. The mineralization of water increased from upper to the lower snow layers. Examples from other geographic regions are given. (Carstea-USGS)
W70-03109

## 2L. Estuaries

**GEOLOGICAL SIGNIFICANCE OF NORTH SEA SAND TRANSPORT RATES,**
National Inst. of Oceanography, Wormley (England).
M. A. Johnson, and A. H. Stride.
Nature, Vol 224, No 5223, p 1016-1017, Dec 6, 1969. 2 p, 1 fig, 4 ref.

Descriptors: *Sediment transport, *Sands, *Bottom sediments, *Tidal waters, *Ocean currents, Tidal effects, Bed load, Sand waves, Ripple marks, Sediment yield, Provenance.
Identifiers: *North Sea, *Netherlands, *England.

In the southern part of the southern bight of the North Sea, tidal currents reach peak speeds of about 2 knots and the sea floor is composed of medium sand in large waves transverse to the flow. In the northern part, tidal currents are weaker and the floor of well-sorted fine sand is flat or ripple marked. The net sand transport is south to north, with erosion in the south and deposition in the northern reaches. Water depth is about 80-120 ft., both tidal and wind-driven currents are important. Transport rates obtained by use of a theoretical model using estimated currents, results of lab studies, wave measurements, and sedimentation data are consistent with quantitative data on sea floor changes. The small steady transport rate can be obscured by large storm flow events, but it is quantitatively more significant over long periods. The yearly net sand transport is about 2.4 million cubic meters. (Knapp-USGS)
W70-02864

**THE CHESAPEAKE BAY INSTITUTE WAVE FOLLOWER,**
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 07B.
W70-02872

**SALTWATER INTRUSION IN THE UNITED STATES,**
American Society of Civil Engineers, New York. Hydraulics Div.
For primary bibliographic entry see Field 04C.
W70-02940

**CALORIC AND CARBON EQUIVALENTS OF ZOOPLANKTON BIOMASS,**
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Marine Ecology Lab.
Trevor Platt, Vivien M. Brawn, and Brian Irwin.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2345-2349, 1969. 1 fig, 11 ref.

Descriptors: *Biomass, *Carbon, *Methodology, Zooplankton.
Identifiers: Caloric equivalents, Energy flow, Predictive equations, Second-order equations.

On the basis of zooplankton samples analyzed for caloric content, carbon, and ash, the dependence of caloric content of zooplankton (y) on percent organic matter (x) was described by the quadratic equation y = -3370 + 136x --0.514 x-squared. Carbon content and caloric content were highly correlated r = 0.94, 21 degree of freedom. Variation in energy equivalent of zooplankton (calorie/gram dry weight) was fivefold; variation appears as result of changing age distributions and species composition among plankton. Carbon content can be used as a reliable predictor of energy equivalent by the equation calorie/gram dry weight = -227 + 152 (% carbon). Multiple correlation coefficient among calories, carbon content, and ash was 0.98 (16 degree of freedom). Where carbon and ash contents are known, caloric content is predicted by the equation calorie/gram dry weight = 1351 + 106 (% carbon) -21.2 (% ash), with standard error of estimate being 253 calories. The seasonal variations in caloric content (fivefold variation caloric variation versus 14-fold variation in dry weight) suggest an expression of a compensatory mechanism in energy flow. (Voigtlander-Wisconsin)
W70-02967

**DO MARINE CRUSTACEANS RELEASE DISSOLVED AMINO ACIDS,**
Virginia Inst. of Marine Science, Gloucester Point; and Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-02976

**EVALUATION OF FLOW IN TIDAL REACHES OF THE CONNECTICUT RIVER BY MATHEMATICAL MODEL,**
Geological Survey, Washington, D.C.; and Geological Survey, Hartford, Conn.
Chintu Lai, Frederick H. Ruggles, and Lawrence A. Weiss.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 16 p, 9 fig, 4 tab.

Descriptors: *Estuaries, *Rivers, *Mathematical models, River flow, Model studies, Water supply, Sewage disposal, Unsteady flow, Boundaries (Surfaces), Discharge (Water), Tidal waters, Channel morphology, Theoretical analysis.
Identifiers: Connecticut River, Characteristics method.

The Connecticut River has been used for many years for domestic and industrial water supplies, sewage disposal, agriculture, and recreation. The growing economic importance of this river has increased the demand for more reliable flow information in the estuary. Because of the unsteady nature of the flow, there are only limited streamflow data available prior to 1965, which probably limited the ability of engineers to design facilities to properly utilize its water. Research work in the field of unsteady open-channel flow led to digital models using mathematical methods, such as the method of characteristics. The unsteady flow computation using this technique was first performed for a short reach and extended later to a much longer reach. This mathematical method requires boundary value and channel geometry data as computer inputs. In addition, occasional discharge measurements through tidal cycles are necessary to determine essential coefficients and parameters, and to provide a means for checking the accuracy of modeling. With such a theoretical analysis of unsteady flow, the following stream hydrology data are now economically obtainable for engineering design: space- and time-wise variations of stage, velocity, and discharge; volume interchange; water-surface profile and its movement; and flushing time. (Carstea-USGS)
W70-03075

# 03. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3A. Saline Water Conversion

**THERMOSORB PROCESS FOR DESALTING WATER,**
Marquardt Co., Van Nuys, Calif.
A. W. Venolia.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.65. Office of Saline Water Research and Development Progress Report No 502, Dec 1969. 67 p, 33 fig, 10 tab, 13 ref. OSW Contract No 14-01-0001-1469.

Descriptors: *Desalination processes, *Activated carbon, *Resins, *Ion exchange, Separation techniques, Economic efficiency, Temperature, Thermal capacity, Aqueous solutions, Methodology, Sodium chloride, Feeding rates.
Identifiers: *Thermosorb process, Aqueous sodium chloride, Kinetic technique.

Experimental results are described that indicate carbon beds provide an attractive alternative to desalting with thermally cycled ion exchange resins. Inexpensive raw materials were used with moderate temperatures. No evidence of a durability problem was encountered in an uninterrupted desalting run of more than 2000 hr. Beds of salt-sorptive carbons appear to be competitive with the resin beds on the basis of effective capacity per weight of sorbent. Carbons probably will outperform ion exchange resins on the basis of initial cost and durability. (Lang-USGS)
W70-02844

**GRAPHITIC OXIDE CONTAINING REVERSE OSMOSIS MEMBRANES,**
Westinghouse Electric Corp., Pittsburgh, Pa.
L. C. Flowers, P. K. Lee, E. S. Bober, M. H. Gjertsen, and Daniel Berg.
Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $1.75. Office of Saline Water Research and Development Progress Report No 418, Apr 1969. 202 p, 33 fig, 27 tab, 28 ref, 1 append. OSW Contract No 14-01-0001-550.

Descriptors: *Membranes, *Reverse osmosis, *Desalination processes, Clays, Clay minerals, Bentonite, Temperature, Acidity, Salts, Ions, Feeding rates, Sodium chloride, Membrane processes.
Identifiers: *Graphitic oxide membranes, Salt rejection efficiency, Vermiculite membranes, Bentonite membranes.

Reverse osmosis membranes containing graphitic oxide and membranes formed from bentonite and vermiculite were tested. The graphitic oxide membranes were tested by varying the temperature, pH, sodium chloride concentration and salt-ion valence of the feed solutions. These membranes showed a decrease in salt rejection from 85-90% to 75% with time, while flux increased from 2-5 to 7-10 gpd per sq ft. Aging may be the reason for the changed performance. Bentonite membranes with sodium hexametaphosphate or tannic acid as edge modifier had a rejection efficiency of 57% and 60% respectively. The efficiencies of vermiculite membranes were approximately 10%. (Carstea-USGS)
W70-02845

**STUDY OF METHODS TO RETARD COMPACTION OF CELLULOSE ACETATE MEMBRANES IN REVERSE OSMOSIS DESALINATION,**
DeBell and Richardson, Inc., Hazardville, Conn.
Bernard Baum, Stanley A. Margosiak, and William H. Holley.
Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Rep No 467, Oct 1969. 75 p, 13 fig, 17 tab, 18 ref, 2 append. OSW Contract No 14-01-0001-1177.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, Cellulose, Pigments, Reinforcement, Permselective membranes, Permeability, Desalination apparatus, Compaction, Aluminum, Silicates.
Identifiers: *Cellulose acetate membrane, Unfilled membrane, Burgess KE reinforced membrane.

Cellulose acetate can be effectively crosslinked with hexamethoxymethyl melamine, acetyl acetonate titanium chelate, sodium dichromate, or lead oxide to prevent desalination membrane compaction. Only pigment reinforcement was promising in preventing the creep of pastics under mechanical stress. Flat membranes were tested for salt rejection, intrinsic salt permeability, intrinsic water permeability, and thickness before and after desalination use in a high-pressure reverse osmosis desalination apparatus. The following types of membranes were used in experimental work: (1) unfilled membranes; (2) Burgess KE reinforced membranes and (3) Burgess KE reinforced and coated membranes. Burgess KE on anhydrous, organic-coated aluminum silicate was the most effective pigment tried for reducing wet compressive creep. (Carstea-USGS)
W70-02846

**ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,**
Midwest Research Inst., Kansas City, Mo.
Fred R. Rollins, Jr.
Rep avail for sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.50. Office of Saline Water Research and Development Progress Rep No 444, June 1969. 39 p, 22 fig, 4 ref. OSW Contract No 14-01-0001-1718.

Descriptors: *Calcium sulfate, *Scaling, *Analytical techniques, *Desalination, Instrumentation, Heat transfer, Water temperature, Velocity, Research and development.
Identifiers: Ultrasonic detection, Transducers, Scale detection.

A study of ultrasonic reflectivity at liquid-metal interfaces where calcium sulfate scale is present led to a technique useful for fixed-station scale detection in saline water conversion plants. Small high-temperature transducers can be soldered directly to the outside surface of heat-transfer tubes. With suitable electronic gear, the system provides nearly exponentially decaying echo trains at frequencies from a few megahertz up to 20 MHz. These echo trains remain remarkably stable at water temperatures as high as 280 deg F and flow velocities of 3 ft/sec. The decay rate of the echo train is strongly affected by the presence of scale on the inside surfaces of the heat transfer tube. The sensitivity of the technique for scale detection increases with increased frequency; but problems such as attenuation by water ultimately set an upper limit on a practical frequency. The decay rate also depends on the exact nature of the scale. The technique appears to be capable of detecting deposits with thicknesses of 1 mil or more.
W70-02847

**STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW: PART 1. DESIGN AND COST ESTIMATE.**
Oak Ridge National Lab., Tenn.

Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.50. Office of Saline Water Research and Development Progress Rep No 389, Mar 1969. 78 p, 2 fig, 8 tab, 3 ref, 2 append. ORNL-OSW Agreement No 14-01-0001-534.

Descriptors: *Cost analysis, *Desalination processes, *Desalination plants, Brines, Flow, Capital costs, Economics, Design criteria, Distillation.
Identifiers: Multistage flash distillation plants, Oak Ridge National Laboratory.

Cost estimates were obtained for a 250-mgd multistage flash desalination plant designed by the Oak Ridge National Laboratory. Development of design criteria was based on the assumption that the plant would be located in southern California. Preparation of cost estimates included capital, operating and maintenance costs. A 250-mgd multistage flash desalination plant can be built at a cost of $149,725,000. Annual operating costs with a 5.6% charge rate will amount to 20.6 cents/1000 gallons. (See W70-02850). (Carstea-USGS)
W70-02849

**STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW: PART 2. PRELIMINARY ENGINEERING ANALYSIS AND CAPITAL COST ESTIMATE.**
Bechtel Corp., San Francisco, Calif.

Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.50. Office of Saline Water Research and Development Progress Rep No 389, Mar 1969. 176 p, 26 fig, 2 tab, 4 ref, 3 append. Oak Ridge Nat Lab-OSW Agreement No 14-01-0001-534 ORNL-Bechtel Corp Subcontract No 3084.

Descriptors: *Capital costs, *Desalination plants, Brines, Flow, Distillation, Cost analysis, Evaporators, Economics, Design criteria, Design flow.
Identifiers: *Multistage flash distillation plants.

A preliminary engineering review was made and a capital cost estimate was made of a 250-mgd multistage flash evaporator desalting plant. The following work was performed: (1) structural, mechanical, instrumentation and electrical engineering review of the plant design provided by the Oak Ridge National Laboratory; (2) a preliminary estimate of capital cost for the plant. A 250-mgd plant could be designed and built in southern California for $149,725,000. The costs of spare parts and replacements were not included in this estimate. (See W70-02849). (Carstea-USGS)
W70-02850

**LIMITING CURRENTS IN ELECTRODIALYSIS MEMBRANE CELLS,**
N. W. Rosenburg, and C. E. Tirrell.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 4.1-4.11, Sept 1969. 11 p, 6 fig, 3 tab, 15 ref.

Descriptors: *Electrodialysis, *Membrane processes, *Desalination processes, Electrochemistry, Chemical properties, Water purification, Saline water, Electrolytes, Ion transport, Currents (Water), Turbulent flow, Efficiencies.
Identifiers: Electrodialysis cell design.

High density currents passed through cells containing ion-transfer membranes are limited by concentration gradients occurring at membrane-solution interfaces. In unstirred solutions, high electrical resistance pH changes, and low current efficiencies occur if ratios of current density to solution concentration in meq per cc are above 50 ma per sq cm. By using high velocity solution flow past membrane faces, this limiting current ratio can be increased to above 500. High linear velocities, thin cell spacing, and in the streamline flow region, closely spaced eddy-promoting obstructions are desirable to maximize permissible current densities. It is concluded that turbulent flow, to be effective, must be obtained by increased velocity instead of increased cell thickness. (Knapp-USGS)
W70-02851

**HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 1. THE GROWTH RATE OF ICE CRYSTALS IN FLOWING SUB-COOLED WATER,**
Syracuse Univ., N.Y.
Jacques Poisot.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Report No 370, p 1-23, Nov 1968. 23 p, 11 fig, 3 tab, 14 ref. OSW Grant No 14-01-0001-1455.

Descriptors: *Growth rates, *Crystal growth, *Desalination processes, *Ice, Freezing, Ice-water interfaces, Melting, Brines, Flow, Heat transfer, Cooling, Fresh water.
Identifiers: *Ice crystal growth, Subcooled water flow.

The formation of ice crystals which are later melted to regenerate pure water is involved in freezing processes for desalting saline waters. Growth rates of single ice crystals in flowing subcooled water and brine are discussed. The design of a new cell made it possible to reduce the time necessary to prepare the run itself. Four water velocities have been studied; namely 1.0, 2.18, 8.0 and 16.0 cm/sec, and the degrees of subcooling varied between 0.05 deg C and 0.70 deg C. The growth equation predicts a zero growth in quiescent water for any degree of cooling. The experimental data show that variation of the flow velocity allows control of the heat transfer away from at least part of the crystal. As a practical application it seems possible to save on cost of refrigeration by increasing the fluid velocity, or to obtain growth as fast as desired. The industrial application is more complex and is briefly described. (See W70-03074). (Carstea-USGS)
W70-03073

**HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 2. THE RATE OF FORMATION OF FREON 31 HYDRATE,**
Syracuse Univ., N.Y.
Gilbert M. Roux.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Report No 370, p 24-71, Nov 1968. 48 p, 10 fig, 17 tab, 22 ref, append. OSW Grant No 14-01-0001-1455.

Descriptors: *Rates, *Hydrates, *Desalination processes, Hydration, Sodium chloride, Sea water, Temperature, Crystallization, Salts.
Identifiers: Methyl-bromide hydrate, Hydration desalination.

The development of the hydrate process for seawater desalination requires the knowledge of the reaction rate of the hydrate used (F-31). The formation rate of F-31 hydrate was studied in aqueous solutions of sodium chloride in a one gallon continuously stirred reactor. The main independent variables studied were the effects of agitation, temperature driving force, salt concentration, and fraction of liquid hydrating agent. Liquid F-31 has been found to hydrate 6 times as fast as does methyl bromide for the same agitation rate (0.07 hp/gal). Above temperature differences greater than 0.3 deg C and for 0.19 hp/gal input to the reactor, the reaction rate varies approximately as the square of the temperature difference. The presence of 5.3 wt.% NaCl causes a decrease in the reacation rate, presumably because of transport of salt away from the crystallization site. The rate was found to be dependent on the relative amount of liquid hydrating agent in the reactor when this amount was less than 3% by volume. (See W70-03073). (Carstea-USGS)
W70-03074

**CONCENTRATION OF SEAWATER BY ELECTRODIALYSIS,**
Japan Monopoly Corp.
M. Kaho, and T. Watanabe.

Paper presented at 3rd Symposium on Salt sponsored by Northern Ohio Geological Survey, Salt Institute, and Solution Mining Research Council, Cleveland, Ohio, Apr 21-24, 1969. Industrial Water Engineering, Vol 6, No 11, p 30-32, Nov 1969. 3 p, 4 fig.

Descriptors: *Desalination, *Electrodialysis, *Salts, *Byproducts, *Costs, Membrane processes, Separation techniques, Electrochemistry.
Identifiers: Salt production (Electrodialysis).

The sea is the sole raw material for salt production in Japan, and 120,000 tons or 13% of the total annual production of salt is now obtained by electrodialysis. The cost of salt production can be reduced by increasing the operating current density, improving the membrane permselectivity to univalent ions, the utilization of by-products, and a combination of a dual purpose plant (power generation and desalination) and salt production with ion-exchange membranes. The dual purpose plant will make it possible to obtain concentrated seawater which in turn will make operation at higher current densities than at present feasible. (Knapp-USGS)
W70-03079

## 3B. Water Yield Improvement

**PRECIPITATION AFFECTS INCREASES IN STREAMFLOW AFTER CONVERTING BRUSH TO GRASS IN ARIZONA,**
Agricultural Research Service, Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Alden R. Hibbert.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 22 p, 5 fig, 2 tab, 7 ref.

Descriptors: *Water yield improvement, *Clear-cutting, *Watershed management, *Rainfall-runoff relationships, *Arizona, Precipitation (Atmospheric), Streamflow, Brush, Grasslands, Seasonal, Rainfall, Winter, Summer, Water yield, Demonstration watersheds.
Identifiers: Chaparral removal.

Water yield has increased substantially on two small chaparral watersheds in central Arizona following control of brush and conversion to grass. The increases in streamflow on the treated watersheds have varied from 1.5 to 14.0 inches per year during the past 7 years. Winter precipitation appears to be the dominant factor controlling the amount of increase. Summer rainfall normally accounts for about one-third of the annual precipitation, but generally has little effect on streamflow. When annual precipitation is less than 16 inches, the increase in water yield for that year is likely to be less than 2 inches. However, the efficiency of the conversion for producing extra water improves as rainfall increases, at least up to 34 inches. At 34 inches of annual precipitation, the increase in flow may reach 12 inches or more, depending on seasonal distribution of the rainfall. (Carstea-USGS)
W70-02882

**THE CHANGING ROLE OF WATER IN ARID LANDS,**
Gilbert F. White.
Tucson, Arizona, The University of Arizona Press, 1962. 15 p.

Descriptors: *Arid lands, *Water management, Recreation, Water allocation, Industrial water, Urbanization, Population, Pricing, Irrigation, Water supply, Forecasting.
Identifiers: Trends, Santa Cruz Valley, Colorado basin, Social aims, Public attitudes, Nomadism, Recreational use.

A few trends may be noted from the spotty experience of the arid one-third of the earth's land

surface. The current vogue of projecting our resource future by extrapolating past trends in the use and supply of natural wealth has heuristic value in trying to ascertain the future but it carries the danger of these trends being accepted as possible guides for that growth. Sometimes they obscure realization that a present view of resources in itself shapes future use of those resources. As such, the author is provided with an excuse for reviewing familiar experience with water management. Today's vision of the role of water in the Santa Cruz Valley, in the Colorado basin, and in the arid zone as a whole, seems likely to affect the complex of individual decisions determining how remaining waters of those areas will be allocated or reallocated for human use in the decades ahead. According to the framework of public attitudes in which both familiar and unfamiliar hydrologic facts are arranged, water may be cast in roles which will either inhibit or advance social aims. These public attitudes may be expected to reflect in some measure the sweeping changes in social progress and its forces and in turn determine the water allocation decisions of the future. (Loeb-Rutgers)
W70-03014

**DELINEATION OF SHEAR ZONES AND APPLICATION TO RESERVOIR ENGINEERING USING APOLLO 9 MULTISPECTRAL PHOTOGRAPHY,**
Alabama Geological Survey, Tuscaloosa.
For primary bibliographic entry see Field 07B.
W70-03069

**EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,**
Agricultural Research Service, Coshocton, Ohio. Corn Belt Branch.
Frank J. Dragoun.
Paper No H-28, presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 13 p, 3 fig, 3 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Cultivation, *Surface runoff, *Water yield improvement, Grasslands, Crops, Land use, Watersheds (Basins), Runoff, Nebraska, Great Plains, Watershed management.
Identifiers: Hastings (Neb).

More than a million acres of marginal cropland have been converted to permanent vegetation in the Great Plains, and conversion is proposed for many more acres. This report presents results of research showing the effect of drastic changes in land use on watershed surface runoff from 4-acre watersheds near Hastings, Nebraska. Surface runoff was significantly reduced two years after converting marginal cultivated fields to perennial grass, and was representative of runoff from native meadow after the third year. Conversely, runoff increased greatly the first year after native meadow was placed in cultivation. (Carstea-USGS)
W70-03088

**WATER-RESOURCES APPRAISAL OF CLAYTON VALLEY-STONEWALL FLAT AREA, NEVADA AND CALIFORNIA,**
Nevada State Dept. of Conservation and Natural Resources, Carson City.
F. Eugene Rush.
Nevada Department of Conservation and Natural Resources, Water Resources-Reconnaissance Series, Report 45, 1968. 54 p, 6 tab, 1 map, 3 fig, 34 ref.

Descriptors: *Nevada, *Arid lands, *Groundwater, *Water yield, *Water resources, California, Evapotranspiration, Groundwater basins, Valleys, Groundwater movement, Subsurface flow, Water quality, Saline water, Alkaline water, Mineral industry, Spring waters, Hydrologic aspects, Geology, Geologic formations, Phreatophytes, Hydrologic data, Surveys.

This report is a water resource reconnaissance appraisal of the Clayton Valley-Stonewall Flat area which extends from just south of Tonapah, Nevada, to the north end of Death Valley, California. Hydrologic characteristics of the 6 valleys of the study area are summarized. Evapotranspiration accounts for most of the natural discharge from the Clayton Valley while subsurface flow accounts for most of the loss from the remaining valleys. The only important perennial yield is an estimated 22,000 acre feet per year from the Clayton Valley of which only 2,000 is developed at present. The general geological structure and physiography of the area are discussed. The average growing season ranges from about 120 to 200 days depending upon elevation. General intervalley groundwater flow is from north to south with the southernmost units discharging into Death Valley. The area is located in a rain shadow, with average precipitation in the valleys of from 3 to 6 inches. Some mountain areas receive as much as 15 inches. Surface water flow is minimal. The groundwater quality ranges from fair to poor for agriculture and is marginal for domestic use. (Crouse-Arizona)
W70-03231

## 3C. Use of Water of Impaired Quality

**SALINITY TOLERANCES OF CERTAIN TROPICAL SOILS AND RELATIONSHIPS BETWEEN SODIUM ION ACTIVITIES AND SOIL PHYSICAL PROPERTIES,**
Hawaii Univ., Honolulu.
S. A. El-Swaify, L. D. Swindale, and G. Uehara.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.55. Office Saline Water Research and Development Progress Report No 419, Mar 1969. 49 p, 15 fig, 14 tab, 74 ref. OSW Grant No 14-01-0001-673.

Descriptors: *Tropical regions, *Soils, *Soil physical properties, *Soil chemical properties, *Hawaii, Calcium, Magnesium, Sodium, Soil water, Irrigation water, Hydraulic conductivity.
Identifiers: *Tropical soils, Soil salinity tolerances, Peptization.

Two tropical soils from Hawaii were tested for salinity tolerances, the ability of the soils to resist physical deterioration by saline waters. Hydraulic conductivity measurements showed that presently permissible limits of salinity and sodium in irrigation water can be safely raised because significant hazardous physical conditions are not likely to occur. Both soils possess high resistance to detrimental peptization even when exposed to extreme sodic conditions. The original acidities of soils are highly resistant to change under leaching. Neither soil had a tendency to accumulate soluble salts by extraction from percolating saline waters. The direct determination of ionic activities for sodium, calcium and magnesium ions as a new and more fundamental tool in soil salinity work is discussed. (Carstea-USGS)
W70-02848

**UTILISATION OF SALINE WATER: THE ROLE OF DESALINATION,**
Australian Mineral Development Labs., Adelaide.
N. V. Blesing, R. E. Wilmshurst, and J. D. Melbourne.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water, held at Adelaide, Feb 20-21, 1969, p 3.1-3.9, Sept 1969. 9 p, 3 tab, 3 ref.

Descriptors: *Desalination, *Desalination processes, *Costs, Water quality, Water utilization, Water chemistry, Water demand, Saline water, Groundwater, Surface waters, Water supply Economics.
Identifiers: *Australia.

If sea-water is excluded, the role of desalination in permitting increased utilization can be shown to fall into one of two major categories, depending on the end use of the water. In one broad category are municipal uses - including domestic, industrial and agricultural, while the other includes pastoral applications. The water quality required for each of these uses is reasonably well defined, and the appropriate standards are presented and discussed. The processes available for achieving these qualities are reviewed and technical problems outlined. Comparative cost data are presented. A number of problems, not widely recognized, are defined, and approaches are suggested which may lead to wider recognition of the value of saline water. (Knapp-USGS)
W70-02854

**SOME EXPERIENCE IN LEACHING OF SALINE SOILS IN SOUTH KAZAKHSTAN (RUSSIAN),**
Ya. D. Kalinin.
Gidrotekhnika i Melioratsiya, No 8, p 66-75, Aug 1969. 2 fig, 8 tab, 7 ref.

Descriptors: *Saline soils, *Leaching, Climates, Seasonal, Crops, Cotton, Humidity, Irrigation engineering, Soil chemistry, Clays, Water demand, Plants, Geology, Groundwater, Water loss, Evaporation.
Identifiers: *USSR, Kazakhstan.

Methods for analysis of ground salt contents and leaching as deep as 40 meters are described on the basis of their application to a 2000-acre area in the saline area of Kazakhstan. The use of 3,500 to 7,500 cum of leaching water per acre on ground containing 0.75 to 1.75% salt gives the best results. Formulas are available to calculate the necessary water volumes for achieving efficient leaching in soils of various chemical compositions. (Gabriel-USGS)
W70-03124

**INTRASOIL UTILIZATION OF SEWAGE WATER SEDIMENTS (RUSSIAN),**
Institute of Medical Parasitology and Tropical Medicine (USSR).
N. A. Romanenko.
Gidrotekhnika i Melioratsiya, No 8, p 92-95, Aug 1969. 1 tab, 10 ref.

Descriptors: *Sewage disposal, *Sewage treatment, *Soil formation, *Soils, *Soil treatment, Pollutants, Agricultural engineering, Biological communities, Biology, Sampling.
Identifiers: *USSR, Sewage water sediments.

A method of introducing sewage water sediments into the soil and the results obtained are discussed on the basis of the data obtained at an experimental station in the Moscow region. Use of relatively shallow furrows for the introduction of sewage-water sediments into the soil leads to a higher productivity of several crops, such as potatoes, beets, etc. (Gabriel-USGS)
W70-03125

**A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,**
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
Charles W. Wilson, and Robert P. Centrell.
Available from the Clearinghouse as PB-189 085, $3.00 in paper copy, $0.65 in microfiche. Paper presented at American Society of Agricultural Engineers, Southwest Region, Baton Rouge, Louisiana, Apr 3-5, 1968. 34 p, 4 tab, 34 ref, 6 fig. OWRR Proj No A-009-LA.

Descriptors: *Irrigation practices, *Effluents, *Sewage disposal, *Waste water (Pollution), Legal aspects, Public health, Economic feasibility, Biochemical oxygen demand.
Identifiers: Lincoln Parish (La).

The sewage effluent used for irrigation acts as a natural fertilizer, and, such use is expected to increase the pollution abatement of streams and rivers. The technical aspects of using sewage effluent for irrigation purposes are: Corrosion potential, plugging effect of sprinkler nozzles, effect of storage reservoirs on effluent quality, effect of salts on soil and crops, effects of effluent on infiltration, effects of effluent on soil organisms, and fluctuating supply and demand for irrigation water. The following public health aspects are discussed: Organisms present in sewage effluent, pollution of soil and groundwater, and pollution abatement of water ways. Some legal aspects are discussed. The economic benefits of irrigation in humid areas depend large on good management practices. An economic analysis was made for each irrigation system in Lincoln Parish, Louisiana. (Grossman-Rutgers)
W70-03159

**BRIEF INTRODUCTION TO SOME BASIC KNOWLEDGE ON SALINE SOILS,**
Ching-Sheng Ch'en.
Available from the Clearinghouse as AD-692 153, for $3.00 in paper copy, $0.65 in microfiche. Ti Li (Geography), No 1, p 35-40, 1966. Edited translation FTD-HT-23-1109-68.

Descriptors: *Soil salinity, *Soil-water-plant relationships, *Saline soils, *Salts, Irrigation practices, Soil physical properties, Soil chemical properties, Salt tolerance, Irrigation, Drainage, Farm management, Agriculture, Plants, Climatic zones, Rice, Damages, Crop response, Soil classifications, Topography, Hydrogeology.
Identifiers: *China, Ning-hsia region, China.

The types of salts found in saline soils are listed and the effects on soil properties and plants of each salt are discussed. Saline soils are classified by degree of salinity. The types of crops that can be grown in each saline class are discussed. No agricultural crops will grow in soils with salt content of 1 percent or more. Virtually nothing will survive at 3 percent salt content. Types of soil salinity in various regions of China are presented in tabular form. The climatic conditions associated with saline properties in various regions are discussed. The dangers of secondary salinization are presented by region. Finally, the influence of proper irrigation and farming practices can improve or eliminate salinity problems. Application of too much water, rice growing in the wrong soil, or improper drainage can create a salinity problem. (Crouse-Arizona)
W70-03226

## 3D. Conservation in Domestic and Municipal Use

**WATER SUPPLY FOR PORT-AU-PRINCE,**
Centrale Autonome Metropolitaine d'Eau Potable (Haiti); MacLaren International Ltd., Toronto (Ontario); and Engineering-Science, Inc., Arcadia, Calif.
E. Limousin, H. Fennerty, and R. G. Ludwig.
Water and Sewage Works, Vol 116, No 7, p 272-275, July 1969. 4 p, 1 fig, 1 photo.

Descriptors: *Water supply, *Water sources, *Water management (Applied), *Municipal water, Water consumption, Water conveyance, Scaling, Water distribution (Applied), Water policy.
Identifiers: Port-au-Prince (Haiti).

Port-au-Prince, Haiti, currently obtains its water supply from springs which issue from the slopes of the Morne l'Hopital mountain ridge. The Morne l'-Hopital is a limestone massive of the Oligocene period. Its geologic structure includes faults and fractures and it is along these faults that the springs appear. The yield of these springs has been increased by the construction of sub-surface collection pipe systems in the alluvial material and by tunnels (infiltration galleries) driven horizontally into the slopes of the Morne l'Hopital. The water supply sources serving the Metropolitan area are characterized by their relatively high calcium hardness, alkalinity and carbon dioxide. In addition they are in a state of supersaturation in varying degrees with respect to calcium carbonate. The present criteria for operation of the distribution system is that all consumers receive water for at least one hour per day. The average daily per capita requirement for the study area is estimated at 46 gpd. For fire, an allowance of 500 gpm was adopted for all areas except the main downtown district of the city, where an allowance of 1,000 gpm was adopted. The problem of supersaturation should be amenable to conventional treatment methods. First phase improvements are designed to supply the source and transmission needs through the year 1978. (Knapp-USGS)
W70-02870

**CONSTRUCTION OF WATER MAINS AND SEWERS IN POPULOUS COUNTIES, LAKE IMPROVEMENTS, AND CONSERVATION OF NATURAL RESOURCES.**

Wis Stat Ann secs 60.29 (16), 60.29 (19), 60.29 (29) (1957), 60.29 (44) (Supp 1969).

Descriptors: *Wisconsin, *Sewers, *Conservation, *Lakes, Conduits, Cities, Administrative agencies, Real property, Riparian land, Riparian rights, Projects, Project planning, Design, Cost, Construction, Value, Assessments, Benefits, Land use, Natural resources.
Identifiers: *Improvements.

Town boards may improve any lake situated in such town. The expense of such work may be paid by the town or by the owner of the property benefited, but assessments on real estate may not exceed the benefits accruing to it. Whenever a majority of the owners of riparian property on any lake petition for improvements, the town board shall make the improvements and assess benefits and damages as provided by this law. When authorized by town meetings, town boards may appropriate up to $5,000 annually for the conservation of natural resources or for payment to bona fide nonprofit organizations for conservation within town limits. Work on lakes and streams in the town must be approved by the State Conservation Commission. (Duss-Florida)
W70-02914

**RECLAMATION OF WASTEWATER.**
Los Angeles City Dept. of Water and Power, Calif.
For primary bibliographic entry see Field 05D.
W70-03141

**ACQUISITION OF WATER RIGHTS BY PUBLIC WATER SUPPLY AGENCY.**

Pa Stat Ann tit 32, secs 632-641 (1967).

Descriptors: *Pennsylvania, *Water rights, *Public utilities, *Water supply, Water sources, Eminent domain, Water yield, Water permits, Permits, Water policy, Water, Water management (Applied), Water contracts, Water control, Water utilization, Legislation, Legal aspects, Regulation, Administrative agencies, Appropriation.

Water rights of any public water supply agency which are unused within one year after the effective date of this act are hereby declared null and void. No acquisitions of water rights shall preclude the future acquisition of water rights in the same source unless the water supply shall within one year produce to the Water and Power Resources Board the record upon which such acquisition is founded. It shall be the duty of the Board to consider and pass upon such claims and to keep the Water Acquisitions Record. An actual taking of water for public use shall be construed as prima facie evidence of the validity of the claim, and confirmation by the Board shall constitute a validation of the right. No public water supply agency shall hereafter acquire water except as provided in this act. Any such agency desiring to acquire new water rights shall make application to the Board, which shall make necessary investigations and issue permits or modification orders. The Board may revoke permits for non-use or extend the time for acquiring said water rights. Such agencies shall have the power of eminent domain regarding rights named in the Board's permit. (Smith-Florida)
W70-03191

**MUNICIPAL CORPORATIONS.**
Ohio Rev Code Ann secs 743.17, 743.25, 743.39 (Page 1953).

Descriptors: *Ohio, *Water works, *Water pollution, *Eminent domain, Legislation, Local governments, Cities, Public utilities, Pollutants, Streams, Water pollution control, Toxins, Construction, Dams, Canals, Water conveyance, Projects, Surveys, Maintenance, On-site investigations, Condemnation, Right-of-way, Domestic water, Pollution abatement.
Identifiers: *Raceways.

A municipal corporation whose water works territory is contiguous to another municipal corporation's territory may establish and maintain an advisable portion of its water works within the limits of the other municipal corporation. The pollution of a running stream used as a domestic water source by a municipal corporation is prohibited. A municipal corporation may enter upon private land to examine and survey for the purposes of building dams, canals, locks, and raceways, or transporting water. The municipal corporation has the right of eminent domain in connection with the public service enterprises. (Powell-Florida)
W70-03206

## 3F. Conservation in Agriculture

**MAJOR USES OF LAND AND WATER IN THE UNITED STATES WITH SPECIAL REFERENCE TO AGRICULTURE-SUMMARY FOR 1964,**
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 06D.
W70-02891

**GENERAL ECONOMIC ASPECTS OF UTILIZATION OF UNDERGROUND WATER FOR IRRIGATION IN HIGH PLAINS OF TEXAS,**
Vernon T. Clover.
Department of Economics, Texas Technical College, Lubbock, 1961. 147 p.

Descriptors: *Economics, *Irrigation, Texas, Climate, Geology, Playas, Lakes, Recharge, Conservation, Value, Prices, Income, Taxes.
Identifiers: *Underground water, High Plains, Geography, Economic indicators, Land values.

The purpose of this study was two-fold: (1) to bring together the economically significant facts concerning the use of underground water for irrigation in the High Plains of Texas, and (2) to discover and analyze the general economic implications of these conditions. Chapter 6 of this study provides five indicators of the economic value of underground water. They are: (1) the relationship between land values and the prevalence of irrigation; (2) the relative dependence of farmers upon irrigation as indicated by (a) the percentage of farm land irrigated, and (b) the percentage that irrigated acreage was of harvested acreage; (3) the difference between the market prices of irrigated and dryland farms; (4) the differences between dryland and irrigated farms in regard to yields and the amount of net return to land and management; and (5) the relationship between the percentage of farm land irrigated and the dollar sales per acre. (Loeb-Rutgers)
W70-03010

**LAND AND WATER DEVELOPMENT IN SOUTHERN FRANCE,**
National Co. for the Management of the Lower Rhone and Languedoc Region.
P. Lamour.
In: Comparisons in Resource Management, Baltimore, Johns Hopkins Press, 1961, p 227-250, 34 p, 1 map.

Descriptors: *Agriculture, *Water resources development, *Irrigation, *Economics, Canals, Industries, Economic impact, Water use, Transportation, Navigation, Waterways, Rainfall, Rivers, Flooding, Dams.
Identifiers: *Rhone-Languedoc, *Economic balance, *Power generation, Public utility works.

This article deals with the efforts to improve the use of land and water resources in the Lower Rhone-Languedoc area of Southern France during the past ten years. These efforts are designed to bring a balanced renewal of all economic and social activities to this area and to bring income stability and job opportunities to its inhabitants. The main effort of the development program is an irrigation works system, which was proposed and started in 1957, and which should be concluded around 1980. This irrigation system permits a rapid and spectacular improvement both in agriculture and industry and is drawing many individuals to the area. The development has brought about the disappearance of the 'French desert areas,' and has generated significant economic and social growth in the region. The policies of this program may prove relevant to similar water problems and conditions in the United States. (See Vol. 2, No. 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03023

**SUBSURFACE IRRIGATION RESEARCH IN ARKANSAS,**
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
John P. Hoskyn, and Billy B. Bryan.
Available from the Clearinghouse as PB-189 081, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Center Publication No 3, Arkansas University Experiment Station Report Series 179, June 1969. 28 p, 12 fig, 5 tab, 15 ref. OWRR Proj No A-002-ARK.

Descriptors: *Irrigation, *Irrigation systems, *Subsurface irrigation, *Application equipment, Irrigation design, Equipment, Laboratory tests, On-site tests, Pipes.
Identifiers: Plastic pipe, Pipe perforating techniques.

Subsurface irrigation of cotton was studied to determine and evaluate the hydraulic problems in distributing water in small-diameter perforated plastic pipe at low pressures and to develop optimum design criteria. A greenhouse study of a subirrigation system indicated that 2 psi should be considered as a lower-limit pressure when orifices are built into the pipe wall. A placement depth of 12 inches was preferable to 18 inches in terms of the amount of water required. Twelve inches was used as the depth of placement for a field subirrigation system. From the standpoint of seasonal soil moisture levels and from observations of the system in operation, the following conclusions are drawn: (1) a pressure head of 6 feet of water is preferable to 10 feet, (2) 38-inch lateral spacing is preferred over 76-inch spacing, and (3) an orifice spacing of 30 inches is preferable to a spacing of either 12 or 48 inches. Internal plugging of orifices because of poor quality water was evident. A sufficient selection of valves, timers, engine motor controllers, etc., is already commercially available. (Knapp-USGS)
W70-03063

**PROBLEM OF ALLOWING FOR THE INFLUENCE OF AGRICULTURAL MELIORATION PRACTICES ON FLOW IN THE CONSTRUCTION OF A GENERAL PLAN FOR THE UTILIZATION AND PROTECTION OF THE WATER RESOURCES OF THE USSR,**
For primary bibliographic entry see Field 04C.
W70-03110

**EVAPORATION WATER LOSSES UNDER SPRINKLING IRRIGATION CONDITIONS (RUSSIAN),**
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 02D.
W70-03121

**FROM MECHANIZATION TO AUTOMATION OF FARM CROP IRRIGATION PROCESS, (RUSSIAN),**
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
N. I. Rabinovich.
Gidrotekhnika i Melioratsiya, No 8, p 31-36, Aug 1969. 2 fig, 2 tab, 1 ref.

Descriptors: *Farm management, *Crop production, *Irrigation practices, *Irrigated land, *Mechanical control, *Automation, Sprinkler irrigation, Productivity, Personnel, Statistics, Cost analysis.
Identifiers: *USSR, Irrigation process automation.

A statistical study of the devices and sprinkling systems used for the irrigation of farm lands in the USSR is described. Their technical and economic characteristics are discussed and a detailed table shows costs associated with introduction and construction of automated sprinkling systems, on the basis of the experience gained during their construction and operation at 5 agricultural sites of the USSR. (Gabriel-USGS)
W70-03122

**SPRINKLING IRRIGATION ON LIGHT CHESTNUT SOILS IN THE VOLGOGRAD REGION (RUSSIAN),**
G. E. Listopad, and G. I. Chizhikov.
Gidrotekhnika i Melioratsiya, No 8, p 44-46, Aug 1969. 3 fig, 2 tab.

Descriptors: *Sprinkler irrigation, *Chestnut soils, *Application equipment, Crops, Crop response, Parametric hydrology, Runoff, Soil density, Statistics, Evaporation.
Identifiers: *USSR, Volgograd region.

The effects of continuous and discrete sprinkling, sprinkling intensity, and the speed of motion of a sprinkling device on chestnut soils of the Volgograd region were experimentally investigated. In irrigation of the chestnut soils of the Volgograd region, the intensity of continuous sprinkling irrigation should not exceed 0.2 to 0.4 mm/min. In using discrete sprinkling, this rate can be considerably increased (up to 3 times). Higher speed of motion of sprinkling devices leads to higher productivity. (Gabriel-USGS)
W70-03123

**COMPUTER SIMULATION PROGRAMMING: AN AID TO THE SELECTION AND MANAGEMENT OF CENTER PIVOT SPRINKLER SYSTEMS,**
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman, and A. Bauer.
Available from the Clearinghouse as PB-189 079, $3.00 in paper copy, $0.65 in microfiche. C.S.A.E. Conference Report, Saskatoon, Saskatchewan, Aug 1969. 31 p, 5 fig, 2 tab, 3 append. OWRR Project B-007-NDAK.

Descriptors: *Simulation analysis, *Sprinkler irrigation, *Management, *Design, *Input-output analysis, Droughts, Planning, Economic feasibility, Crop production, Soils, Water balance.
Identifiers: Center pivot sprinkler.

A computer simulation model was developed for a center pivot sprinkler irrigation system. The objective of the study was to simulate the operating characteristics of the center pivot sprinkler system which would permit the imposition of management scheme variations and offer improved methods of analyzing the suitability of designs for specific applications. The simulation program included (a) the definition of input variables, (b) water balance computations (c) 'when' to irrigate determination (d) 'which' field to irrigate determination, (e) drought day, stress period and yield potential evaluations, (f) yearly summary computation and (g) long record summary. The simulation program was applied to several selected combinations of soils and crop rotations in North Dakota. The data obtained in the study provided the planner with a base on which to estimate the physical adequacy, operational practicality and economic potential associated with a particular design. (Thiuri-Cornell)
W70-03162

**CONSERVANCY DISTRICTS--IRRIGATION DISTRICTS.**

Ohio Rev Code Ann sec 6101.73 (Page 1953).

Descriptors: *Ohio, *Irrigation districts, *Regulation, *Irrigation permits, Legal aspects, Flood protection, State governments, Legislation, Permits, Project planning, Irrigation programs, Condemnation, Drainage, Drainage systems, Compensation, Water rights, Flow.

The formation of irrigation districts is authorized and shall be organized by the court. Such court shall require proof that the organization and operation of the irrigation district will not interfere with any works or plans for flood prevention or the drainage of lands, or materially diminish their protective value. The deprivation of land lying upon any stream or the deprivation of the ordinary flow of water in such stream shall cause the owners thereof to be duly compensated if caused by the operation of the district. Taxes shall be levied and bonds issued as provided by this act and the power of the board of directors, as conferred generally by this act, shall stand subject to this section. (Barnett-Florida)
W70-03208

**PREDICTION OF FLOW RESISTANCE IN FURROWS FROM SOIL ROUGHNESS,**
Colorado Agricultural Experiment Station, Ft. Collins.
D. F. Heermann, R. J. Wenstrom, and N. A. Evans.
American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 482-485, 489, 1969. 1 tab, 2 fig, 6 ref.

Descriptors: *Furrow irrigation, *Irrigation efficiency, *Flow resistance, *Roughness coefficient, *Agricultural engineering, Irrigation, Infiltration, Energy gradient, On-site investigations, Colorado, Statistical methods, Soil physical properties, Roughness (Hydraulic), Resistance, Equations, Surface irrigation, Data collections, Model studies, Stochastic processes.
Identifiers: *Resistance coefficient, *Water advance rate, *Water recession rate, *Soil roughness.

Efficient surface irrigation is possible only with the proper combination of rates of water advance, and recession and thus, infiltration depth. Resistance to flow in furrows caused by surface roughness has an effect on all 3 factors. Studies of surface-roughness characteristics were carried out near Fort Collins and Grand Junction, Colorado. The field procedures are described in detail. The resistance coefficient is related empirically to the standard deviation of roughness height by an equation developed from laboratory observations. It was found that this relationship can be applied directly to field conditions for the range of discharges studied in rectangular and parabolic channels. In the field the standard deviation of roughness height was estimated with 6 randomly selected one-foot

records. It was found that for short furrow reaches (20 to 40 feet) the energy gradient could differ greatly from bottom slope. Therefore, caution must be used in predicting hydraulic variables with the bottom slope in place of energy gradient. On the other hand, for furrows of 140 feet or more, energy gradient can be replaced with bottom slope without serious errors in prediction. (Crouse-Arizona)
W70-03221

**SOIL MOISTURE ON NATIVE GRAZING LANDS IN THE SEMIARID NORTHERN PLAINS OF USA,**
Agricultural Research Service; and Montana Agricultural Experiment Station, Bozeman.
Walter R. Houston.
Annals of Arid Zone, Vol 7, No 2, p 230-234, 1968. 5 p, 2 tab, 1 fig, 4 ref.

Descriptors: *Soil moisture, *Semiarid climates, *Moisture stress, *Stocking, *Grazing, Soil properties, Soil compaction, Moisture availability, Livestock, Carrying capacity, Loam, Clays, Silts, Montana, Great Plains, Moisture stress.

The amount and duration of available soil moisture is critical for plants in arid and semiarid lands. A study of soil moisture conditions on 3 soils near Miles City, Montana was conducted. There was one range that had been heavily grazed for over 20 years and one only lightly grazed during that time. There were significant differences in soil moisture associated with intensity of grazing. Soil moisture was measured to 107 cm depth. During the favorable year soil moisture increased at 46 cm. and below in loam soil with heavy stocking, while there was less moisture accumulation with light stocking. Apparently there were more deeply rooted plants under light stocking. In contrast, on silty clay soil moisture accumulation at 76 cm. and below was greatly reduced under heavy grazing, probably due to soil sealing and compaction from livestock trampling. During the drought year the soil became dry under both conditions. Prolonged drought reduced forage production to the same level under both grazing conditions possibly owing to death of some plants in the lightly stocked range. (Crouse-Arizona)
W70-03222

**THE DEVELOPMENT OF AN IRRIGATION BUDGET,**
Department of Agriculture, Edmonston (Alberta). Water Resources Div.; and Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
H. A. Kerr, and J. M. Murray.
Canadian Agricultural Engineering, Vol 10, No 1, p 12-16, 1968. 1 tab, 3 fig, 15 ref.

Descriptors: *Irrigation, *Irrigation efficiency, *Soil-water-plant relationships, *Soil moisture, *Moisture availability, Irrigation practices, Agriculture, Plant growth, Nuclear moisture meters, Moisture tension, Root zone, Wilting point, Field capacity, Moisture content, Arid lands, Semiarid climates, Atmometers, Evapotranspiration, Water balance, Estimating, Alfalfa, Bromegrass.
Identifiers: *Canada, *Irrigation budget, Saskatchewan.

In arid and semiarid lands irrigation is used to supplement rainfall so that agricultural crops will not be deprived of water required for proper development. An adequate yet efficient irrigation schedule is not possible without knowledge of water requirements of crops and soil moisture conditions. For 2 years soil moisture levels were measured under irrigated stands of alfalfa and brome grass in Saskatchewan, Canada, with a neutron gauge. Measured soil moisture in the top 4 feet of soil was compared with calculated soil moisture using Bellani plate atmometer readings. Soil moisture as predicted from calculated soil moisture budget closely paralleled measured soil moisture. The calculated moisture budget considered the effects of crop height, soil and plant rooting characteristics on the rate of soil moisture use, as well as the evaporation potential. The budget calculation technique is described and graphs are presented comparing measured and estimated soil moisture. (Crouse-Arizona)
W70-03223

**PERFORMANCE OF TILE DRAINS UNDER IRRIGATION IN SOUTHERN ALBERTA,**
Department of Agriculture, Lethbridge (Alberta); and Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
E. Rapp, and G. E. Laliberte.
Canadian Agricultural Engineering, Vol 10, No 2, p 64-69, 1968. 2 tab, 6 fig, 11 ref.

Descriptors: *Irrigation, *Saline soils, *Saturated soils, *Drainage systems, *Tile drainage, Arid lands, Semiarid climates, Groundwater, Subsurface drainage, Drainage effects, Loam, Sands, Tiles, Irrigation engineering, Water table.
Identifiers: *Canada, Alberta.

In an arid environment where irrigation is necessary to agricultural production, tile drains are often used to prevent water logging and salinity or to reclaim soil that was originally saline. The proportion of water applied that must be handled by the drainage system will vary according to soil, water and climatic conditions. The study was conducted in southern Alberta to provide guide lines for designing irrigation drainage systems for that area. Five tile drain systems were tested in areas of sandy loam and loams over sand for a 12-year period. Two interceptor tile drain systems proved highly effective in removing excess water and salts. The performance of three relief tile drains was highly variable. Since salinity of the effluent from relief drains showed no decrease with time, they were judged doubtful for reclamation purposes although they did effectively remove excess water. If relief drains are to be used, the authors suggest that spacing should be no more than 700 to 800 feet to achieve greater effectiveness. (Crouse-Arizona)
W70-03227

**COMMITTEE REPORT. SOIL SCIENCE IN RELATION TO WATER RESOURCES DEVELOPMENT: III. SOIL MOISTURE CONSERVATION.**
Soil Science Society of America, Inc., Madison. Water Resources Committee.

Soil Science Society of America, Proceedings, Vol 33, No 3, p 480-482, 1969. 3 ref.

Descriptors: *Soil science, *Evapotranspiration, *Evaporation control, *Agriculture, *Water resources development, Soil moisture, Water loss, Soil surfaces, Stomata, Solutes, Mulching, Great Plains, Arid lands, Semiarid climates, Water conservation, Consumptive use, Water amanagement (Applied), Water utilization.

Though all plants require water for growth, some utilize moisture more efficiently than others. Rarely is more than 2% of the water consumed converted into usable products. An estimated 70% of annual precipitation in the U.S. is consumed in evapotranspiration. If only 10% of this could be conserved through more efficient plant use or soil surface conservation, the additional amount available for urban industrial use would be significant. Movement of water into and through soil is reviewed in this article and possible areas for conservation are indicated. Ideally, agriculture would remove from the soil only that moisture required for satisfactory plant development. Soil scientists are conducting studies such as stomatal control, fogging to reduce atmospheric demand, use of barriers against direct evaporation from the soil surface and use of water of higher solute content. Continued efforts of soil scientists can make more nonagricultural uses compatible with agricultural needs. (Crouse-Arizona)
W70-03230

**RANGELAND DEVELOPMENT IN KENYA,**
Ministry of Agriculture and Animal Husbandry, Nairobi (Kenya). Range Management Div.
D. J. Pratt.
Annals of Arid Zone, Vol 7, No 2, p 179-208, 1968. 2 tab, 3 fig, 17 ref.

Descriptors: *Arid lands, *Range management, *Water resources development, *Rural sociology, *Long-term planning, Brush control, Carrying capacity, Grazing, Vegetation regrowth, Soil conservation, Water shortage, Land tenure, Water table, Social adjustment, Social impact, Economics, Economic feasibility, Management, Welfare (Economics), Ecology, Plant ecology, Wildlife, Grasslands, Population, Governments, Programs, Research and development, Tropical regions, Conservation.
Identifiers: *Kenya, *Pastoralism, East Africa.

In arid and semiarid grazing regions of Africa increased population and demand for food has placed tremendous pressure on the land. The indigenous population has attempted to use these dry lands according to traditional methods, thereby creating a major socioeconomic problem. An intricate approach toward this problem is being attempted in Kenya. The objective is to develop planning and management programs based on careful studies of the ecology, sociology, land tenure, and natural resources of the area. Each of these factors is reviewed in some detail with emphasis on the peculiarities of East Africa and Kenya in particular. It is concluded that a key to encouraging the social change necessary to changing subsistence pastoralism into commercial livestock production lies with establishment of secure tenancy to adequate management units. But land title should be given only when there is evidence that adequate water development, animal health, and sound management procedures are being followed. (Crouse-Arizona)
W70-03232

**RECENT ADVANCEMENTS IN THE USE OF STANDARD CLIMATIC DATA FOR ESTIMATING SOIL MOISTURE,**
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
For primary bibliographic entry see Field 02G.
W70-03233

**DROUGHT HAZARDS TO SEED GERMINATION,**
Nottingham Univ. (England). School of Agriculture.
Walter Heydecker.
Annals of Arid Zone, Vol 6, No 1, p 22-34, Mar 1967. 9 tab, 1 fig, 14 ref.

Descriptors: *Droughts, *Germination, *Soil moisture, *Moisture availability, *Seeds, Drought tolerance, Bulk density, Soil temperature, Soil types, Moisture stress, Field capacity, Planting management, Soil-water-plant relationships, Arid lands, Solutes, Salinity, Osmotic pressure, Plant physiology, Compacted soils, Crop response.
Identifiers: *Water potential, Seedlings.

Germination trials of researchers are reported in a discussion of effects of drought, high soil temperatures and salinity on seed germination. Not all of the studies reviewed were conducted in normally arid lands but the conditions are common to arid lands. The degree of drought under which seeds germinated varied substantially by species. Thus, cabbage and corn seeds could germinate under much drier conditions than onions, carrots, or lettuce. In many cases high temperatures such as are common in arid lands interacted with low soil moisture to further inhibit germination. From data presented it was also apparent that too much soil moisture might also suppress germination. Germination of cabbage and spinach, for example, was much higher at soil water potential of -1.0 atmospheres than under drier conditions or at field capacity. Germination was also better in loamy media with good moisture conductivity than in

media of lower bulk density with resulting poor moisture conductivity. This suggests desirability of compression of low bulk density soils to make more moisture available to germinating seeds. Crusting, however, should be avoided since this can mechanically interfere with successful emergence after germination has taken place. Osmotic potentials of salt solutions in the soil water can also impede germination of seeds in a manner similar to actual moisture stress. Finally, even if the seed does germinate there must be sufficient soil moisture to permit successful development of a root system if the seedling is to grow further. In general the information reported can be useful in developing successful irrigation practices in arid lands. (Crouse-Arizona)
W70-03234

**LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: AZERBAIDZHAN LEADER REVIEWS LAND RECLAMATION,**
V. Yu. Akhundov.
Translated from Bakinskiy rabochiy, Nov 19, 1968. p 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 17-23, 1969.

Descriptors: *Land reclamation, *Irrigated lands, *Project planning, *Construction, *Coordination, Working conditions, Human resources, Salinity, Alkalinity, Gypsum, Arid lands, Soil conservation, Erosion control, Water quality, Water resources development.
Identifiers: *USSR, *Azerbaidzhan.

In 1965 some 162,000 of 1,278,000 hectares of irrigated land were not in production. Since then 11,100 hectares of new lands have been irrigated, others have improved water supplies and agricultural use of irrigated land is up to 97.1%. Productivity remains unsatisfactory. Salinity and alkalinity have become problems. In 1967 a plan called for applying gypsum to 21,800 hectares. Application was carried out on only 725 hectares. There is poor coordination among the several agencies involved in land reclamation and improvement. There is a shortage of skilled labor and technical personnel. Lack of adequate housing and cultural facilities in the newly developed lands also exists. There must be an improvement in determining and meeting completion dates and in the quality of construction on water control systems if agricultural productivity goals are to be met. There is a need for more careful consideration of economic efficiency in planning and executing irrigation and agricultural development projects. There is also a necessity for better forestry practices in the water source areas to protect them from erosion and decline in water quality. (Crouse-Arizona)
W70-03240

**LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: TADZHIK PARTY LEADER REVIEWS ROLE OF IRRIGATION,**
D. R. Rasulov.
Translated from Kommunist Tadzhikistana, Nov 20, 1968. p 2, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 7-10, 1969.

Descriptors: *Irrigation projects, *Working conditions, *Project planning, *Coordination, *Water resources development, Drainage systems, Arid lands, Irrigated land, Irrigation, Productivity, Labor supply, Investment, Rural areas, Urbanization, Management, Personnel, Land reclamation.
Identifiers: *USSR, *Tadzhikistan.

In Tadzhikistan, USSR, efforts to bring new arid land into cultivation with irrigation have been sharply reduced in effectiveness because of poor coordination between agencies. For example, some 24,000 hectares provided with irrigation in the Zafarobod area show low productivity because housing and cultural facilities were not provided for a potential labor force. In Yavan only 44% of the funds allocated for housing in 1968 was actually used. Major capital investments have been frozen in unproductive irrigation projects owing to lack of coordination between agencies. In several locations productive irrigated land is being encroached upon by urban sprawl. An estimated 70,000 hectares are nonproductive because of lack of drainage systems. A new agency-the Ministry of Rural Construction-has been organized to provide needed housing, roads and community buildings. However, it is slow in attacking the problem because of substandard quality construction and lack of skilled personnel. Full scale reform and a systematic approach to rural development is necessary. (Crouse-Arizona)
W70-03241

**LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: TURKMEN PARTY LEADER OUTLINES IRRIGATION PLANS,**
B. Ovezov.
Translated from Turkmenskaya iskra, Nov 29, 1968. p 1, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 11-16, 1969.

Descriptors: *Land reclamation, *Irrigation projects, *Working conditions, *Project planning, *Salinity, Drainage, Rural areas, Irrigation canals, Irrigated land, Land development, Soil conservation, Erosion, Drainage systems, Irrigation practices, Arid lands, Agriculture, Planning, Land forming.
Identifiers: *USSR, *Turkmenistan, Karakum Canal, Land leveling.

During 1966-1967 more than 2 million hectares were newly irrigated and drained throughout Turkmenistan, USSR. Reclamation has become a major part of agricultural activity there. Productivity has greatly increased on the collectives. Technical personnel with higher education increased from 2,100 in 1963 to 3,400 in 1968. Capital construction increased by 67%. In Turkmenistan improved irrigated land increased by 110,000 hectares. Construction of the Karakum Canal has continued until it now irrigates some 210,000 hectares including 140,000 of virgin lands. Drainage systems have been improved with 3,200 km. of collectors built. Some areas are still unproductive due to salinity and erosion. The current five-year plan calls for 90,000 additional hectares of irrigated land, improved irrigation practices on 200,000 hectares and leveling of 300,000 hectares. Current planning for the Karakum Canal scheme calls for a total of 600,000 hectares of irrigated land by 1980. For this plan to be successful, there must be increased construction of housing and other improvements in rural working conditions. (Crouse-Arizona)
W70-03242

**LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: KIRGIZ PARTY LEADER DISCUSSES IRRIGATION PROBLEMS,**
T. V. Usubaliyev.
Translated from Sovetskaya Kirgiziya, Nov 27, 1968. p 2, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 1-6, 1969.

Descriptors: *Land reclamation, *Irrigated land, *Irrigation operation and maintenance, *Productivity, *Alkalinity, Saturated soils, Salinity, Irrigation efficiency, Irrigation practices, Economic efficiency, Leaching, Water conveyance, Water loss, Water management (Applied), Grazing, Range management, Labor supply, Agriculture, Land forming.
Identifiers: *USSR, *Kirgiz, Land leveling.

Irrigation problems in Kirgiz are discussed. Work on irrigation has been done, but many of the areas with irrigation water supply have low productivity. More than 4 million hectares are in poor condition due to water logging, salinity, alkalinity and stony conditions. Millions of rubles worth of production are lost yearly to saline conditions. The new five-year plan calls for new and improved drainage systems, improvement of existing irrigations systems, and extensive land leveling. Total irrigated land will increase by 19,000 hectares and 61,000 hectares of grazing land will be provided with water. The irrigation water supply to 100,000 hectares will be increased and 28,000 hectares will be leveled. These plans will require improved efficiency in water development organizations and more effective investment planning. One-half of the water supply is lost in transfer through poorly built or maintained irrigation systems. Part of the trouble is caused by poor coordination among agencies and poor working and living conditions for labor. (Crouse-Arizona)
W70-03243

# 04. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control of Water on the Surface

**FLOOD PLAIN INFORMATION, AMERICAN FORK AND DRY CREEK, AMERICAN FORK AND LEHI, UTAH.**
Corps of Engineers, Sacramento, Calif.

Prepared for Utah Div of Water Resources and Utah County. Corps Engineers Flood Plain Report, Nov 1969. 29 p, 15 fig, 8 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Utah, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *American Fork (Utah), Lehi (Utah), Standard project flood, Intermediate regional flood.

Flooding of the American Fork and Dry Creek, Lehi, Utah is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02866

**THE EFFECTS OF THE W. A. C. BENNETT DAM ON DOWNSTREAM LEVELS AND FLOWS,**
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
A. Coulson, and R. J. Adamcyk.
Inland Waters Branch Technical Bulletin No 18, Department of Energy, Mines and Resources, 1969. 9 p, 2 fig, 3 tab.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Regulated flow, Dams, Reservoir storage, Hydroelectric plants, River flow, Low flow.
Identifiers: *Canada, British Columbia, Peace River, Bennett Dam.

The effects on the flow of the Peace River, British Columbia, caused by construction and operation of the W.A.C. Bennett dam are summarized using limited stream flow and water level data. Probabilities of high and low flows to be expected with dam regulation are tabulated. (Knapp-USGS)
W70-02877

**FORECASTING THE RHINE RIVER DISCHARGES (FRENCH),**
Electricite de France, Grenoble. General Technical Div.
For primary bibliographic entry see Field 02E.

W70-02884

**A STUDY OF DRAINAGE CONDITIONS ON A HILLSIDE RECEIVING SEWAGE PLANT WASTE WATER EFFLUENT AT WEEKLY INTERVALS,**
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 05E.
W70-02893

**MISSISSIPPI WATER RIGHTS LAW,**
For primary bibliographic entry see Field 06E.
W70-02897

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (NON-STATUTORY RULES),**
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 491-503, May 1953.

Descriptors: *Reasonable use, *Subsurface waters, *Water law, *Underground streams, Riparian rights, Prior appropriation, Groundwater, Hydrologic cycle, History, Percolating water, Judicial decisions, Water policy, Water resources, Artificial use, Competing uses, Legal aspects, Natural use, Ownership of beds, Administrative decisions, Water allocation, Usufructuary right.

While the law regarding surface water is well settled along the lines of reasonable use and rights of riparian owners, the law of underground waters is not as well defined. Three groups of non-statutory rules exist today. The English common law rule is that percolating water existing in the earth is regarded as a part of the soil in which the person owning the land has a property right. This principle is based upon the maxim, to whomsoever the soil belongs, he owns also the sky and to the depths. Early American decisions followed this rule. In later cases, the reasonable use or American rule was developed. When the absolute water rights of one owner conflict with the absolute water rights of another, the person causing the injury must show a reasonable use in connection with the land from which the water is taken and a lack of malice. The California or correlative rights, rule recognizes situations where both land owners want to use the water reasonably on their land, and the supply is insufficient. Here, apportionment of the water provides a solution. (See W70-02898). (Schram-Florida)
W70-02899

**CONSTITUTIONAL LAW--NAVIGABLE WATERS--EXTENSION OF THE FEDERAL PEROGATIVE,**
Orton Alan Jones.
W Va L Rev, Vol 63, No 1, p 59-62, Dec 1960. 4 p.

Descriptors: *Navigable waters, *Tributaries, *Federal-state water rights conflicts, *Judicial decisions, Federal government, State governments, Regulation, Eminent domain, Watershed management, Flood control, Hydroelectric power, Admiralty, Water law, Federal jurisdiction, Non-navigable waters.
Identifiers: Commerce power.

United States v Grand River Dam Authority, 80 S Ct 1134 (1960), held that Congress may, under the commerce clause, regulate the water flow of a navigable stream. When it does so, there is no taking of property within the meaning of the Fifth Amendment. Under the commerce power, Congress can treat watersheds on navigable streams and their tributaries, and on non-navigable tributaries of navigable streams, as vital to flood control, and can thereby subject them to federal control. The original rule that federal control of interstate commerce extends to all public navigable lakes and rivers has been expanded by the courts to allow federal control to extend over non-navigable portions of navigable streams, and even over intrastate waterways, if such waterways are part of a continuous interstate system. The instant case permits federal control over not only non-navigable portions of a navigable stream, but also non-navigable tributaries of a navigable stream. The trend is toward a rule that would afford the federal government potential control over all the streams in the country that could be classified as being within the watershed of a navigable waterway. (Barnett-Florida)
W70-02902

**NAVIGABILITY AS APPLIED TO LAKES IN LOUISIANA.**

La L Rev, Vol 6, No 4, p 698-706, May 1946. 9 p, 28 ref.

Descriptors: *Louisiana, *Lakes, *Riparian rights, *Navigable waters, Judicial decisions, Lake beds, Beds, Dry beds, Beds under water, Lake shores, Riparian land, Ownership of beds, Riparian waters, Riparian water loss, Navigation, Bodies of water, Non-navigable waters, Water policy, Accretion (Legal aspects), Boundaries (Property), State governments.

The scope of the laws of alluvion and dereliction and the rights of riparian owners generally do not extend to lakes. According to public policy, the bed of a navigable lake belongs to the state since ownership of the banks by private individuals would practically preclude navigation. The courts have found Articles 509 and 510 of the Civil Code to be inapplicable to lakes, although the proper classification of waterbodies continues to be a source of litigation. A 1910 act provides that beds of lakes not under private ownership are the property of the state, so riparian claims as to non-navigable lakes are against state owned land. Therefore, riparian owners have no claim to the dry bed of a non-navigable lake, since it is either under direct private ownership or is owned by the state. The definition of navigability is not based on whether the body of water has been navigated in the past, but whether it is in fact available for commerce. The burden of proof is on the party who claims that the body of water is navigable. (Douberley-Florida)
W70-02906

**NAVIGABLE WATERS, HARBORS AND NAVIGATION.**
Wis Stat Ann secs 30.01-30.06 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Navigable waters, *Public rights, *Bulkhead line, Legislation, Legal aspects, Resource development, Cities, Transportation, Docks, Piers, Basins, Bulkheads, Beds, Lake Michigan, Administrative agencies, Federal jurisdiction, State jurisdiction, Shores, Regulation, Control, Remedies, United States.
Identifiers: *Harbor facilities, *Dock line, Ferries.

A number of terms are defined, including harbor facility, pier, and wharf. Harbor facility means every facility which is useful in the maintenance or operation of a harbor. Pier means any structure which extends channelward from the shore with water on both sides and which is used to moor or unload watercraft. Wharf means any structure which extends along the shore and which is used to moor or unload watercraft. Whenever there is a violation of the statutes relating to navigable waters or an infringement of public rights therein which the Department of Resource Development believes will not be adequately remedied by imposition of penalty, the Department may order the parties responsible to abate the violation. If the Department's order of abatement is ineffective, the attorney general will institute proceedings for enforcement of the Department's order. A shore line established prior to January 1, 1960 is deemed to be a bulkhead line subsequent to such date; a dock line established prior to such date is deemed to be a pierhead line subsequent to such date. None of the foregoing provisions are applicable to submerged shore lands in Lake Michigan owned by municipalities. The Department may waive the applicability of the foregoing provisions as they relate to navigable waters falling within the concurrent jurisdiction of the United States. (Keith-Florida)
W70-02907

**HARBORS AND NAVIGATION.**

Wis Stat Ann secs 30.30-30.35 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water resources development, *Harbors, *Shore protection, Legislation, Legal aspects, Navigable waters, Cities, Canals, Watercourses (Legal), Navigation, Construction, Maintenance, Administrative agencies, Leases, Comdemnation, Contracts, Regulation, Federal government, Flood control, Dredging, Financing, Riparian land, Riparian rights, Bonding, Railroads.
Identifiers: *Harbor improvement.

Every city having navigable waters within or adjoining its boundaries is authorized to: (1) construct, maintain, and improve harbor facilities; (2) construct and maintain shore protection walls; (3) acquire land by condemnation and make special assessments to carry out the foregoing provisions; (4) cooperate with the federal government in the latter's harbor improvement projects; and (5) lease the wharfing privileges of navigable waters at the ends of streets. The procedural and public policy considerations by which cities are to be guided in carrying out the foregoing powers are set forth. Statutory guidelines are provided for the letting of contracts by cities for the construction, maintenance and improvement of harbor facilities and shore protection walls. Any city operating a public harbor through a board of harbor commissioners may construct, maintain, and operate railway facilities connecting various harbor facilities with one another or with other railroads in the vicinity of the city. Provision is made for the financing of shore protection walls and harbor facilities. (Keith-Florida)
W70-02908

**HARBORS AND NAVIGATION.**

Wis Stat Ann secs 30.77-30.90 (1964).

Descriptors: *Wisconsin, *Boating regulation, *Local governments, *Legislation, Administrative agencies, Boats, Cities, Permits, Boating, Marinas, Boat-launching ramps, Inspection, Aircraft, Financing, Safety, Navigable waters, Public health, Iced lakes, Lakes, Access routes, Recreation facilities, Water pollution.
Identifiers: *Enforcement, *Commercial boating, *Sea planes.

Except as otherwise provided, no municipality may regulate boats or exclude them from the free use of the waters of the state. However, municipalities may adopt regulations relative to the equipment and use of boats consistent with this chapter. Municipalities bordering on inland lakes may regulate the use of boats on those lakes provided all municipalities bordering such lakes have enacted identical regulations. Municipalities may charge fees for using municipally owned launching facilities and may regulate boats carrying passengers for hire. All local regulations must be published. Municipalities may regulate the operation of sea planes on the surface of waters adjoining such municipalities. The state shall give financial aid to municipalities for local enforcement of this chapter by water safety patrol units. The Conservation Commission may establish the jurisdiction of local enforcement units. Such units shall have the enforcement powers of a sheriff. Penalties are provided for violations of this statute. Municipalities may regulate the operation of boats and vehicles on icebound inland lakes. Such regulation shall not render any municipality liable for accidents on regulated lakes. No public access may interfere

with the use of Lions Lake as a recreational area for the physically handicapped. (Dearing-Florida)
W70-02910

**DAMS AND BRIDGES.**

Wis Stat Ann secs 31.30-31.35 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Dams, *Water levels, Mills, Mill dams, Non-navigable waters, Wildlife conservation, Fish passages, Water control, Flow, Rivers, Streams, Lakes, Ponds, Cranberries, Crops, Compensation, Damages, Licenses, Leases, Regulation, Discharge, Trout, Fish management, Conservation, Marshes, Damsites, Dam construction, Natural flow, Obstruction to flow, Regulated flow.
Identifiers: *Penalties (Civil).

With the exception of three specified sites or other sites chosen by the Conservation Commission and the Department of Resource Development, no dams shall be constructed across the Brule River and its tributaries. Such dams are to have adequate fishways for the conservation of trout. Water mills and dams may be erected and maintained on streams non-navigable in fact in accordance with delineated regulations. Municipalities may exercise the same rights upon such streams as upon ones navigable for any purpose. Construction of dams to the injury of any lawfully constructed mill is prohibited. All mills and milldams lawfully constructed on non-navigable streams are subject to regulation by the Department of Resource Development, except that no regulation shall prohibit any owner of flooded land from recovering full compensation for his damages. Licenses are hereby issued to the owners of any milldams. The Department may regulate water levels controlled by such milldams. Persons maintaining dams on navigable streams shall pass at least twenty-five percent of the natural flow at all times. Civil penalties are provided for violations. Dams shall not be operated so as to endanger the water supply to cranberry marshes. (Duss-Florida)
W70-02911

**WATER RESERVOIRS - RIVER IMPROVEMENT CORPORATIONS.**

Wis Stat Ann secs 182.005, 182.016 (1957).

Descriptors: *Wisconsin, *Reservoirs, *Rivers, *Reservoir sites, Legislation, Legal aspects, Water resources, Flow, Flow control, Streams, Dams, Electric power, Local governments, Cities, Land use, Ponds, Bodies of water, Public benefits, Alteration of flow, Regulation, Regulated flow.

The articles of a corporation organized to maintain a system of water reservoirs to regulate the flow of any river must guarantee to owners of water power located below the reservoir system the right to purchase capital stock of the corporation. Corporations' articles may not be amended to withdraw the guaranty. Corporations, private and municipal, may acquire lands necessary for use for ponds or reservoirs if engaged in river improvement activities or furnishing electric power for public purposes. (Casey-Florida)
W70-02915

**MUNICIPAL COOPERATION IN FEDERAL RIVERS, HARBORS OR WATER RESOURCES PROJECTS.**
Wis Stat Ann sec 66.45 (1965).

Descriptors: *Wisconsin, *Cities, *Federal government, *Water resources development, Legislation, Federal jurisdiction, Rivers, Harbors, Navigation, Cost allocation, Construction, Maintenance, Navigable waters, Control, State governments, Administrative agencies, Project purposes, Projects.

Any county, town, city, or village may agree to cooperate with an agency of the federal government in the construction, operation, or maintenance of any federally authorized projects related to rivers, harbors, or water resources management. If more than one municipality is affected, they may agree to act jointly and may submit any determinations of cost allocation or division of responsibilities among themselves to an arbitration board. (Casey-Florida)
W70-02916

**ENLARGEMENT, CONSOLIDATION, DIVISION AND DISSOLUTION OF DRAINAGE DISTRICT.**
Wis Stat Ann secs 88.77-88.83 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage, *Administrative agencies, Drainage programs, Drainage systems, Cost sharing, Local governments, Water policy, Institutions, Decision making, Management, Drains, Cities, Legislation, Legal aspects, Control.

Owners of lands adjacent to a drainage district may petition for annexation to that district. Rules governing procedure for such annexation are provided. Lands receiving benefits from a district may be annexed. Public hearings may result in the consolidation of districts. A landowner may withdraw from a district only where no material injury to the remainder of the district will result. Rules are provided for such withdrawal for the suspension of district operations and for the dissolution of districts on petition of landowners. All debts incurred by a district must be paid before the dissolution of the district. District drains become common waterways subsequent to dissolution. Control of a district within a city may, on petition, be transferred to the city. Requirements and procedure for transfer of control are provided. Transfer may be initiated by landowners or by the city. Money assessed against land in the district is transferred to the city when control over the district is transferred. (Dye-Florida)
W70-02922

**NAVIGATION COMMISSION FOR THE DELAWARE RIVER.**
Pa Stat Ann tit 55, secs 1-16 (1964).

Descriptors: *Pennsylvania, *River regulation, *Permits, *Administrative agencies, Legislation, Planning, Navigable rivers, Governments, Administration, Building codes, Construction, Zoning, Legal aspects, Surveys, Delaware River, Rates, Regulation, Bridge construction, Harbors, Docks, Maintenance, Cleaning.
Identifiers: Licenses, Penalties (Civil).

An appointive administrative commission is created and is to be known as the Navigation Commission for the Delaware River. The Commission's powers are to survey the capacity of the Delaware River and its tributaries for commercial purposes, regulate construction, and adopt and promulgate regulations for construction on the River. It is the duty of the President of the Commission to enforce these regulations, and failure to comply with such regulations is a misdemeanor punishable by fine. Upon application to the Commission, a license to construct any bridge or harbor structure is issued subject to a hearing and approval of plans and specifications and subject to further approval of the Water and Power Resources Board. The license is void unless work is begun within six months after issuance. All structures not in compliance with law are a public nuisance. The Commission may place liens upon docks, with notice, for having the docks cleaned when such docks are not properly maintained by the owners. The Commission regulates rates for dockage and makes annual statements of expenses. All decisions of the Commission are appealable to the court of common pleas. (Barnett-Florida)
W70-02924

**WIDENING OF STREAMS.**

Pa Stat Ann tit 55, secs 261 thru 265 (1964).

Descriptors: *Pennsylvania, *Stream improvement, *Channel improvement, *Ownership of beds, Streambeds, Legislation, Navigable waters, Tides, Highways, Transportation, Width, Depth, Channel morphology, Length, Riparian land, Riparian rights, Navigation, Legal aspects, Cost-benefit ratio, Cost allocation.

The county courts may authorize the widening, deepening, and straightening of all navigable streams affected by ocean tides when both sides of the stream are within Pennsylvania. All laws of the Commonwealth relating to widening and straightening roads and highways are applicable to the widening, deepening, and straightening of these navigable streams. The expenses for the improvements must be borne by the advantaged landowners whose lands border on these streams. When such improvements cause any part of the bed of a stream to be left vacant, title to such bed vests in the adjoining landowner. An application to the court by the owners of two-thirds of the land bordering on a stream is required to make improvements authorized by this statute. All of the owners of land through which the stream passes are directed to make improvements ordered by the courts upon approval of a petition. After the improvements are made, the court is required to confirm and establish the altered stream as a navigable stream and public highway, and to vacate that part of the original stream which may have been rendered useless. (Schram-Florida)
W70-02925

**HARBOR OF ERIE.**
Pa Stat Ann tit 55, secs 361-363, 368-369, 372-374 (1964).

Descriptors: *Pennsylvania, *Harbors, *Port authorities, *Cities, Leases, Marinas, Dredging, Channel improvement, Bridge construction, Boats, Boating regulations, Docks, Water pollution, Soil contamination, Wildlife conservation, Parks, Forests, State governments, Regulation, Ponds, Lagoons, Encroachment, Public benefits.
Identifiers: *Canal basins.

The State Park and Harbor Commission of Erie has full power to maintain and develop all dedicated lands for the purpose of improving the harbor of Erie. The Commission may: (1) contract for the planning, engineering, dredging, filling, bridging, and erection of docks; (2) grant reasonable leases and concessions for the establishment of a suitable harbor for yachts; (3) control waterways, ponds, lagoons, and the operation of boats, docks, and landings; (4) prevent encroachment on lands, channels, and shores of Presque Isle Peninsula; (5) prevent pollution of land or waters; and (6) enact rules for the protection of wildlife. The state dedicates the Presque Island Peninsula to the use of the public. The Erie city authorities may regulate the manner in which the canal basins may be used by the public. The Department of Forests and Waters shall convey to the city of Erie the canal basins and the water property in the Bay of Presque Isle. The water property conveyed is controlled by the city of Erie for the development of the Port of Erie. (Schram-Florida)
W70-02928

**WHARVES AND DOCKS.**

Pa Stat Ann tit 53, sec 16831, 16834, 16836-16840, 16843 (1957).

Descriptors: *Pennsylvania, *Docks, *Low water mark, *Port authorities, Legislation, Construction, Erection, Riparian land, Riparian waters, Banks, Administrative agencies, Administrative decisions, Permits, Piers, Coastal structures, Rivers, Delaware River, Harbors, Channels, Boundaries (Property), Riparian rights.
Identifiers: *Wharf lines.

The waters in rivers outside of the low water mark are the property of the Commonwealth. No owner of land inside of said mark shall erect or extend any wharf in the Port of Philadelphia without first obtaining a license from the Board of Wardens of the port. Riparian owners of land dedicated to public use are deemed owners of land inside the low water mark. The breadth of water front appertaining to adjacent landowners is determined by protracting the lines of the land to the established wharf limit except when this would give the owner more, or any other property owner less, than his proportionate share of frontage on the wharf line. The procedure for establishing wharf lines on the Schuylkill River is outlined, and once established, no wharf shall be extended further into the river than such lines. In making surveys and soundings for such lines, the surveyors may enter upon any land adjoining the Schuylkill. The Wardens of the Port of Philadelphia may determine the extent to which wharves may be built into the Schuylkill. Any person desiring to erect or extend a wharf into the tide-way of the Delaware River must apply to the Board of Wardens. A license will be granted if the wharf will not encroach on or injure the channel or harbor. (Schram-Florida)
W70-02930

**APPROPRIATION OF STREAMS FOR WATER SUPPLY.**

Pa Stat Ann tit 53, sec 2905 (1957).

Descriptors: *Pennsylvania, *Water works, *Water conveyance, *Water supply, Legislation, Streams, Rivers, Easements, Right-of-way, Highways, Railroads, Local governments, Bridges, Farms, Erection, Construction, Appropriation, Cities, Pipelines, Water transfer.

Any city desiring to erect waterworks or improve its water supply may appropriate springs, streams, lands, easements, and rights of way, whether within its territorial limits or not. Any city may also lay pipes across, over, or under any lands, rivers, bridges, highways, and railroads to conduct water obtained outside of its territorial limits. However, no waters or springs shall be used so as to deprive the owner thereof of the free use and enjoyment of them for any domestic or farm purposes. (Schram-Florida)
W70-02931

**BRIDGES, VIADUCTS AND CULVERTS.**
Pa Stat Ann tit 16, secs 2601, 2630-2631, 2652 (1956).

Descriptors: *Pennsylvania, *Culverts, *Bridges, *Embankments, Dikes, Banks, Legislation, Highways, Local governments, Construction, Bridge construction, Abutments, Piers, Streams, Routing, Railroads, Canals, Engineering structures, Stream improvement, Floods, Transportation.
Identifiers: *Altering course of streams.

The county commissioners of any county may locate, construct, widen, straighten, or extend bridges and viaducts over streams and other topographical impediments to public traffic within the county. This applies equally to culverts, necessary approaches, abutments, embankments, fills, and piers. No county may enter any property or act in derogation of the lawful authority of any political subdivision without its consent. In addition, this act does not apply to any matters covered by provisions of the State Highway Law. Whenever it becomes necessary to widen, alter, or straighten the course of any unnavigable stream, the county may enter upon adjacent land and take, injure, and destroy any land necessary to change the course of such stream. Any county may maintain dykes, banks, and causeways across any unnavigable stream for the purpose of protecting county bridges and public highways from tide floods. In connection with this authority, the county may take, injure, and destroy any necessary property. Changes in an existing stream channel requires the approval of the Department of Forests and Waters. If a required embankment or causeway requires more expense than the adjoining townships can bear, it may be entered on the record as a county improvement. (Schram-Florida)
W70-02934

**PREVENTION AND CONTROL OF FLOODS.**

Pa Stat Ann tit 16, sec 1947 (1956).

Descriptors: *Pennsylvania, *Flood control, *Flood proofing, *Local governments, Legislation, Reservoirs, Flood protection, Floods, Streams, Rivers, Storm drains, Drainage systems, Detention reservoirs, Financing, Government finance, Administrative agencies, Maintenance, River regulation, Control systems.

For the prevention and control of floods, the board of county commissioners may: (1) borrow, appropriate, and expend money; (2) acquire real property by purchase or dedication; (3) regulate and control rivers, streams, and storm water drainage systems; and (4) make contracts and expenditures for the cleansing, regulation, and improvement of streams, drainage systems, and storage or retaining reservoirs. The commissioners may also make expenditures for investigating and examining the condition of rivers, drainage systems, and reservoirs. The commissioners may enter into arrangements with other public authorities, either federal or state, to further these purposes. In exercising these powers, the county commissioners may issue interest bearing bonds in accordance with the Municipal Borrowing Law. (Schram-Florida)
W70-02939

**AUTHORITY TO CONTRACT WITH THE UNITED STATES IN FLOOD CONTROL AND DRAINAGE PROJECTS.**
Miss Code Ann sec 8038.3 (1956).

Descriptors: *Mississippi, *Federal government, *Flood control, *Drainage programs, Legislation, Navigation, Navigable waters, Highways, Highway relocation, Drainage, Floods, Federal project policy, Property values, Cost allocation, Water resources development, Navigable rivers, Construction, Construction costs, Contracts.

The State Highway Commission may enter into agreements with the Federal government or any agency thereof for the alteration, relocation, reconstruction, or abandonment of state highways, and the conveyance of all state interest in such property where the property is necessary for the construction of flood control, navigation, or drainage projects approved by the Federal government. These agreements and conveyances shall be made upon payment of a consideration deemed reasonable both by the State Highway Commission and by the agency of Federal government affected. No expenses arising from the creation and maintenance of detours will be paid by the Federal government. (Casey-Florida)
W70-02942

**BRIDGE AND PARK COMMISSIONS.**
Miss Code Ann secs 5974-01, 5974-02, 5974-04 (Supp 1968).

Descriptors: *Mississippi, *Navigation, *Construction, *Harbors, Legislation, Legal aspects, Navigable waters, Cities, Gulf of Mexico, Administrative agencies, Bridge construction, Parks, Contracts, Eminent domain, Dredging, Channel improvement, Reclamation, Maintenance, Piers, Marinas, Jetties, Leases, Fishing, Financing, Surveys, Investigations, Tunnel construction, Boating, Beds, Sewerage, Recreation facilities, Islands, Federal government, Local governments.
Identifiers: *Harbor facilities, Water systems, Ferries.

The purpose of this act is to encourage and assist the economic and commercial development of navigation, harbor, boating, and related facilities in or near the navigable waters of the state. Cities and counties which meet specified standards have the authority to create bridge and park commissions; these commissions have the general power to sue, contract, and exercise eminent domain. In addition, commissioners are specifically granted power to: (1) acquire island located within specified proximity to the city or county for park, recreational, harbor development, and similar purposes; (2) purchase from the state any submerged lands adjacent to such islands for use as filling, provided no obstruction to navigation will be created thereby; (3) construct, build, maintain, and operate bridges, ferries, causeways, or tunnels to connect islands with the mainland; (4) acquire or construct any type of permanent improvements necessary to make commission property usable as public parks, parkways, boulevards, or as otherwise provided; (5) dredge, deepen and widen any channel in aid of navigation and harbor development; and (6) cooperate, consult, and contract with the federal government in furtherance of the foregoing powers. (Kieth-Florida)
W70-02944

**PLANS FOR MULTIPLE USE OF THE WATER RESOURCES IN THE LENA RIVER,**
For primary bibliographic entry see Field 06B.
W70-02949

**THE EFFICIENCY OF HORIZONTAL DRAINAGE LAYERS FOR ACCELERATING CONSOLIDATION OF CLAY EMBANKMENTS,**
King's Coll., London (England).
For primary bibliographic entry see Field 08D.
W70-02953

**FROMME V UNITED STATES (COMPENSATION FOR THE TAKING OF A FLOWAGE EASEMENT).**

412 F2d 1192-1197 (Ct Cl 1969).

Descriptors: *Texas, *Eminent domain, *Easements, *Flooding, Inland waterways, Condemnation, Flood plains, Levees, Rivers, Tributaries, Water levels, Elevation, Channels, Rainfall, Overflow, Spoil banks, Basins, Bays, Runoff, Drainage, Construction, Land use, Legal aspects, Judicial decisions, United States, Floodwater, Compensation.
Identifiers: *Corps of Engineers, Flowage easements.

Plaintiff sued the United States for compensation for the taking of a flowage easement over plaintiff's land. The Corps of Engineers constructed a channel for the Gulf Intracoastal Waterway. A temporary levee and spoil bank were also constructed, as well as a permanent levee. The permanent levee impeded the runoff of floodwaters of the Guadalupe River from claimant's land. The court of claims dismissed plaintiff's petition, holding that there was no taking of a permanent interest in the land. The interference with runoff due to temporary construction ceased to exist upon completion of the channel. Interference due to permanent construction was not so great as to meet the court-established test for creation of a flowage easement. This test was formulated in United States v Cress, 243 US 316 (1917), and requires intermittent, frequent, and inevitably recurring flooding of the land. (Duss-Florida)
W70-02961

**ECONOMICS OF LEAK SURVEYS,**
Pitometer Associates, Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03006

**THE FLOOD CONTROL CONTROVERSY, BIG-DAMS, LITTLE DAMS, AND LAND MANAGEMENT,**
Luna B. Leopold, and Thomas Maddock, Jr.

New York, The Ronald Press Co, 1954. 278 p.

Descriptors: *Flood control, *Dams, *Land management, Water resources, Costs, Benefits, Administration, Zoning, Water systems, Engineering, Levees, Floodways, Channel improvement, Reservoirs, Planning, Flood protection, Cost-benefit ratio.
Identifiers: River flood plain, Flood insurance, Downstream programs, Upstream programs, Federal interest, Local participation.

The purpose of this book is to investigate the facts regarding flood control, a subject that has given rise to extreme controversy in the United States in recent years. Sections of this study deal with: the flood control problem, administrative elements of a flood control program, engineering measures for flood control, land management, downstream and upstream programs for flood control, the federal interest, and local participation. The book considers questions which recur in many resource fields: the definition of the public interest, the allocation of the costs and benefits of resource development, and the economic and political means for carrying this development forward. The controversy over flood control in the United States illustrates the conflicts of interest and opinion that seem bound to arise over matters of resource development and use in any country. Most of these conflicts are complicated. In the present account one can grasp how difficult it is to achieve balanced resource programs and to apportion their cost equitably. It is inevitable that similar controversies should arise in many fields as the use of land and water resources becomes more intensive and competitive and as the economies of the less developed countries are primed toward greater productivity and integration. (Loeb-Rutgers)
W70-03013

**RIVER MANAGEMENT.**
For primary bibliographic entry see Field 06D.
W70-03015

**WEBBERS FALLS LOCK AND DAM, ARKANSAS RIVER NAVIGATION PROJECT; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03028

**GALVESTON BAY HURRICANE SURGE STUDY; REPORT 1, EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03029

**LOW-WATER WEIRS ON BOEUF AND TENSAS RIVERS, BAYOU MACON, AND BIG AND COLEWA CREEKS, ARKANSAS AND LOUISIANA; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03030

**OUTLET WORKS FOR NEW HOPE RESERVOIR, CAPE FEAR RIVER BASIN, NORTH CAROLINA, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03031

**SPILLWAY FOR HUGO DAM, KIAMICHI RIVER, OKLAHOMA; HYDRAULIC INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03032

**CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03033

**FLOOD PLAIN INFORMATION, KERN RIVER, BAKERSFIELD, CALIFORNIA.**
Corps of Engineers, Sacramento, Calif.

Corps of Engineers Flood Plain Report, Oct 1969. 39 p, 25 fig, 10 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, California, Maximum probable flood, Historic flood.
Identifiers: Kern River, Bakersfield (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Kern River, Bakersfield, California is described based on records of rainfall, runoff, and historical and present flood heights. Included are photographs, profiles, and cross sections that indicate the extent of past flooding and flooding which may be expected in the future. Bakersfield and Oildale are cities affected. The information is useful for surveys by water resources managers and others in planning ways to minimize vulnerability to flood damages by better control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Lang-USGS)
W70-03090

**HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, OCEAN SPRINGS-DEER ISLAND QUADRANGLES, MISSISSIPPI,**
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Available from the US Geological Survey, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-405, 1 sheet, 1969. Test, 2 fig, 1 map, 1 photo, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Ocean Springs (Miss), Deer Island (Miss), Tidal floods, Storm tides.

The areas flooded by hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Ocean Springs and Deer Island quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-03097

**FLOODS OF APRIL 28, 1966, IN THE NORTHERN PART OF DALLAS, TEXAS,**
Geological Survey, Washington, D.C.
Willard B. Mills, and Elmer E. Schroeder.
Geol Survey Water-Supply Paper 1870-B, p B1-B37, 1969. 37 p, 18 fig, 2 plate, 1 tab, 8 ref.

Descriptors: *Floods, *Texas, *Storms, Rainfall, Rainfall intensity, Runoff, Rainfall-runoff relationships, Data collections, Hydrologic data, Streamflow, Stage-discharge relations, Hydrographs, Profiles, Flood damage.
Identifiers: Dallas (Texas).

The floods of April 28, 1966, in the northern part of Dallas, Tex., caused heavy damage to a relatively small area. Flood damage was estimated at $2,500,000; and of this amount, $1,330,000 damage was along Bachman Branch, which has a drainage area of 12.3 square miles. At least 7 persons died as a direct result of the floodwaters. The flood was caused by a 5-hour storm in the early hours of April 28. Antecedent rainfall had so saturated the area that the intense, but relatively low, total rainfall (less than a 50-year return period) caused historical floods to be exceeded at many points. A peak runoff rate of 3,160 cfs per sq mi occurred on a 1.5 sq-mi area within the watershed. (Knapp-USGS)
W70-03098

**FLOODS OF JUNE 1965 IN SOUTH PLATTE RIVER BASIN, COLORADO,**
Geological Survey, Washington, D.C.
H. F. Matthai.
Geol Surv Water-Supply Paper 1850-B, p B1-B64, 1969. 64 p, 12 fig, 4 plate, 4 tab, 15 ref.

Descriptors: *Floods, *Colorado, *Rainfall-runoff relationships, Streamflow, Stage-discharge relations, Flood plains, Discharge (Water), Hydrologic data, Data collections, Duration curves, Hydrographs, Profiles, Flood damage, Disasters.
Identifiers: South Platte River, Denver (Colo).

Heavy, intense rains in three areas, on June 14-17, 1965 caused outstanding floods on many streams in the South Platte River basin from Plum Creek, just south of Denver, downstream to the Colorado-Nebraska State line. The flood-producing storms followed a relatively wet period, and rainfall of as much as 14 inches in a few hours was reported. Previous record high discharges on many tributaries with drainage areas on the plains were exceeded, sometimes severalfold. The attenuation of the peak flow by channel storage as the flood passed through Denver was considerable; yet the peak discharge of 40,300 cfs of the South Platte River at Denver was 1.8 times the previously recorded high of 22,000 cfs in a period of record starting in 1889. The 1965 peak would have been still higher except that all flow from Cherry Creek was stored inCherry Creek Reservoir. Descriptions of the storms and floods, detailed streamflow records, and information on damages, flood profiles, inundated areas, and flood frequency are included in this report. Several comparisons of the magnitude of the flood are made, and all indicate that an outstanding hydrologic event occurred. (Knapp-USGS)
W70-03100

**THE EFFICIENCY OF DOUBLE-SIDED CONTROL DRAINAGE SYSTEMS IN THE UKRAINE (RUSSIAN),**
G. G. Afanas'yev.
Gidrotekhnika i Melioratsiya, No 8, p 59-65, Aug 1969. 7 tab, 3 ref.

Descriptors: *Drainage systems, *Efficiencies, *Reclamation, Canals, Soils, Climates, Cost analysis, Economic justification, Dry seasons, Topography, Hydrogeology, Crops, Productivity.
Identifiers: *USSR, Ukraine.

The effect of double-sided control drainage on the productivity and cost of land reclamation was ex-

perimentally investigated. The cost of reclamation in the Kiev region is 150 rubles and 83 rubles per acre using double-sided and one-sided drainage systems, respectively; however the productivity of land under the double-sided drainage control is over 2 times greater than that under the one-sided drainage control. (Gabriel-USGS)
W70-03119

**FLOOD-PLAIN DRAINAGE AND FLOOD DISCHARGES OF THE UKRAINIAN SMALL RIVERS (RUSSIAN),**
Ukrainian Scientific Research Inst. of Hydroengineering and Land Reclamation (USSR).
For primary bibliographic entry see Field 02E.
W70-03120

**COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,**
Chicago Bureau of Engineering, Ill.
For primary bibliographic entry see Field 05G.
W70-03142

**AQUEDUCT CONTROL SYSTEM SAVES $100 MILLION,**
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 08A.
W70-03146

**LOS ANGELES CITY PROPER AND HARBOR MASTER PLAN FOR WATER SUPPLY,**
Los Angeles City Dept. of Water and Power, Calif. Water Engineering Design Div.
For primary bibliographic entry see Field 06D.
W70-03147

**URBAN STORM DRAINAGE CRITERIA MANUAL.**
Wright-McLaughlin Engineers, Denver, Colo.

Work performed for the Denver Regional Council of Federal Governments, Denver, Colorado. Wright-McLaughlin Engineers, Vols I and II, Mar 1969. 726 p, 39 tab, 139 fig, 171 ref. HUD Project Colo P-62.

Descriptors: *Drainage engineering, *Design criteria, *Drainage programs, *Drainage practices, *Storm runoff, *Surface drainage, *Storm drains, *Flood control, Rainfall-runoff relationships, Hydrology, Hydraulic structures, Water law, Administration, Watershed management, Flood proofing, Hydraulics, Intakes, Open channels, Storage, Culverts.
Identifiers: *Denver, *Denver Regional Council of Governments, *Storm drainage policy, Major drainage system, Streets for drainage channels, Curb and gutter design.

The manual was written to suggest techniques, methodology and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. This work appears to be the most comprehensive treatment of urban storm drainage design criteria available. The authors recommend adoption of the manual by government agencies in Metropolitan Denver, and that the Denver Regional Council of Governments provide coordinate drainage activities. Volume 1 includes chapters on suggested drainage policy, Colorado drainage law, drainage planning for initial and major drainage, rainfall data and analyses, rainfall-runoff relationships, storm sewer design criteria and standards, and drainage criteria for the design of streets and storm water inlets. Volume 2 deals with criteria for the design of the 'major' drainage system; i.e., the system which carries the runoff from a storm having a frequency of occurence of once in 100 years. Included are design criteria for open channels, large diameter conduits, box culverts and inlets, energy dissipators, baffle and accelerator chutes, and channel drops. The benefits of temporary storage in reducing peak runoff rates is discussed. Flood proofing techniques, the use of irrigation ditches and benefits of well designed drainage systems are discussed. (See also W70-03149 thru W70-03152). (Poertner-Chicago)
W70-03148

**DRAINAGE POLICY, (Chapter 1).**
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 54 p. HUD Project Colo P-62.

Descriptors: *Design criteria, *Water policy, *Drainage programs, *Drainage practices, *Drainage engineering, *Storm runoff, *Watershed management, *Flood control, Flood proofing, Design standards, Flood plains, Design storm, Storage, Watershed basins, Surface runoff, Drainage, Surface drainage, Drainage systems, Drainage water, Hydrology, Ponding, Rational formula, Flood plain insurance.
Identifiers: *Denver, *Denver Regional Council of Governments, *Storm drainage policy.

The manual was written to suggest techniques, methodology, and guidelines needed to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Policy' recommends the adoption of this manual by government agencies. Storm drainage is presented as a 'space-allocation' problem demanding planning and integration on a regional basis. A set of policy statements, based upon underlying principles, technical criteria, and data is recommended to provide direction for planning, providing, and operating drainage facilities. These statements call for the initiation of flood plain management programs and a program for collecting and analyzing stormwater runoff and flood data. Stormwater drainage master plans, based upon the criteria in this manual and consistent with the comprehensive plan, are encouraged for adoption by each urbanized drainage basin. Coordination by the Denver Regional Council of Governments is suggested. The report includes recommendations for participation by governmental units in the National Flood Insurance Act of 1968. Design criteria discussed relate to storm frequency, initial and major drainage system considerations, natural drainageways, water quality control, and runoff computation. Emphasis is placed upon coordinating drainage planning with transportation and open space planning. (See W70-03148). (Poertner-Chicago)
W70-03149

**SUMMARY OF COLORADO DRAINAGE, (Chapter 2), AND PLANNING, (Chapter 3).**
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 43 p, 6 ref. HUD Project Colo P-62.

Descriptors: *Water law, *Legal aspects, *Legislation, *Natural flow doctrine, *Administration, *Watershed management, *Flood routing, *Water resources planning, *Riparian rights, Water rights, Judicial decisions, Obstructions to flow, Drainage programs, Flood control.
Identifiers: *Denver, *Denver Regional Council of Governments, *Liability for flood damages.

The manual was written to suggest techniques, methodology, and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Law' presents the responsibilities and legal liabilities of municipalities relating to planning, constructing, operating, maintaining and repairing drainage improvements. The importance of obtaining all pertinent facts and developing a plan before initiating a proposed improvement is stressed. Municipalities proceeding in this manner can be relatively assured of no legal complications and should be able to use any of several different means to finance proposed improvements. Specific legal actions are cited and briefed. The chapter on 'Planning' cites drainage systems as being subsystems of the total urban system, affecting orderly growth and development. Planning should include consideration of multiple-uses and additional benefits which can result from well planned drainage systems. Emphasis is placed upon adopting plans which incorporate undisturbed natural swales and waterways. Other aspects discussed include drainage management measures, master planning, flood plain planning, initial and major systems, transportation facilities relationships, open space, and planning and sizing of storm sewer systems. (See W70-03148). (Poertner-Chicago)
W70-03150

**RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).**
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 77 p, 13 tab, 19 fig, 38 ref. HUD Project Colo P-62.

Descriptors: *Rainfall, *Runoff, *Rainfall disposition, *Rainfall intensity, *Hydrology, *Rainfall-runoff relationships, *Storm runoff, *Design criteria, *Drainage engineering, Design storm, Duration curves, Hydrograph analysis, Unit hydrograph, Rational formula, Flood forecasting, Frequency analysis.
Identifiers: *Denver, *Denver Regional Council of Governments.

The manual was written to suggest techniques, methodology and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Rainfall' suggests a rainfall analysis technique similar to that employed by the U.S. Weather Bureau (Technical Papers Nos. 28, 29 and 40). The chapter includes several key rainfall-frequency maps making it possible to determine any combination of return-period from one to 100 years and durations from 5 minutes to 24 hours. Nine isohyetal maps, labeled 'Rainfall depth-Duration-Frequency Map, Denver Region,' are presented. The chapter on 'Runoff' describes in detail the following three methods of calculating runoff applicable to Metropolitan Denver: (1) Rational Method, for sewers draining areas less than 200 acres; (2) Colorado Unit Hydrograph Procedure, for sewers draining basins in excess of 200 acres; and (3) Statistical Analysis, for streams upon which future urbanization will have little effect on runoff inflow. Two statistical methods are illustrated: (1) Log-Pearson Type III, and (2) Index Flood. Flood Plain Information Reports, prepared by the Corps of Engineers for delimiting flood hazard areas and stream surface profiles, are cited. Users are urged to allow for anticipated urbanization. (See W70-03148). (Poertner-Chicago)
W70-03151

**STORM SEWERS (Chapter 6); STREETS AND INTERSECTIONS (Chapter 7); AND STORM WATER INLETS (Chapter 8).**
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 252 p, 18 tab, 60 fig, 36 ref. HUD Project Colo P-62.

Descriptors: *Storm drains, *Drainage systems, *Design criteria, *Hydraulic design, *Intakes, Design standards, Surface drainage.
Identifiers: *Street drainage, *Street design criteria, *Stormwater inlets, Curb and gutter design, Streets for drainage channels.

The manual was written to suggest techniques, methodology and guidelines to facilitate the imple-

mentation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Storm Sewers' presents criteria intended for use by engineers in designing systems of storm sewers for collecting and conveying stormwater runoff to points of discharge in the major drainage system. Design procedures and criteria are recommended for all elements of a typical storm sewer system, including conduits, channels, inlets, bends, junctions, manholes, outlets, pressure systems, and the related hydrologic aspects of rainfall and runoff. The chapter on 'Streets' presents criteria and suggested procedures and standards for street design. Drainage design of streets is approached from the standpoint of providing systems to drain streets and, secondarily, using streets as integral parts of local drainage systems. The chapter on 'Storm Inlets' discusses the various types of inlets devices used for providing openings to drain stormwater from streets into sewers. Design criteria and inlet capacity graphs are treated in detail. Several examples of typical designs of storm sewers, streets, and stormwater inlets are presented. (See W70-03148). (Poertner-Chicago)
W70-03152

**IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,**
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 06A.
W70-03166

**NEW METHODS FOR USING STOCHASTIC PROCEDURES IN WATER RESOURCE PLANNING,**
Computer Technology, Inc., Arlington, Tex.
For primary bibliographic entry see Field 06A.
W70-03171

**WATER TRANSPORT COSTS,**
Binnie and Partners, London (England); and King's Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 06D.
W70-03172

**MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,**
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 06A.
W70-03173

**STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,**
Water Resources Engineers, Inc., Springfield, Va.; and Texas Water Development Board, Austin.
For primary bibliographic entry see Field 06D.
W70-03175

**DIVERSION OF WATERS INTO OTHER STATES.**

N J Stat Ann 58:3-1 (1966).

Descriptors: *New Jersey, *Diversion, *Interstate, *Conduits, Legal aspects, Regulation, Legislation, Pipes, Ditches, Canals, Bodies of water, Transportation, Administrative agencies, Fresh water.

No waters of any well, fresh-water lake, pond, brook, creek, river or stream, nor any subsurface or percolating waters shall be transported or carried through pipes, conduits, ditches or canals into any other state for use therein, except where the consent in writing of the Water Policy and Supply Council of the Division of Water Policy and Supply of the Department of Conservation and Economic Development has been obtained. A petition in writing for such consent must be filed with the Division accompanied by such plans and documents as the Division may require. The Division shall enforce the provisions of this section, and the Superior Court by injunction may, upon application of the Division, prevent any unauthorized diversion or transportation. (Sisserson-Florida)
W70-03179

**BLACKBURN V GAYDOU (FLOOD DAMAGES FROM OBSTRUCTING THE FLOW).**
245 SW2d 161-171 (Mo Ct App 1951).

Descriptors: *Missouri, *Dikes, *Flood damage, *Obstruction to flow, Barriers, Diversion, Streamflow, Natural Flow Doctrine, Relative rights, Judicial decisions, Overflow, Streams, Flow, Natural flow, Surface drainage, Surface runoff, Surface waters, Drainage, Drainage water, Damages, Earthworks, Diversion structures, Weather patterns, Natural use, Repulsion (Legal aspects), Overflow.

Plaintiff alleged that defendant negligently constructed a dike in a creek flowing along the north side of both plaintiff's and defendant's land thereby obstructing the creek's natural flow, which caused an overflow onto plaintiff's land. Plaintiff asked for temporary and permanent damages. The court held that while a cause of action was stated, plaintiff was not entitled to damages for a permanent injury. Surface water is a common enemy which may be warded onto the land of an adjacent or lower owner. However, it may not be unneccessarily collected and discharged to the lower owner's damage. The upper owner may not discharge water in a different manner than it would usually have gone in the natural course of drainage, nor may a natural stream be dammed and the waters diverted to the damage of property without compensation therefor. However, the injury here did not occur until three years after construction of the dike, and a continued injury would depend upon weather conditions. (Smith-Florida)
W70-03181

**SWAMP LAND GRANTS AND THE CONSERVATION FUND.**
Wis Stat Ann secs 25.235, 25.29 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Financing, *Reforestation, *Conservation, Legislation, Legal aspects, Swamps, Overflow, United States, Arkansas, Permits, Administrative agencies, Fishing, Leases, Marshes, Schools (Education), Economics, Expenditures, Government finance, Income, Taxes, Land development, Land management.

The Congress of the United States passed an act to enable the state of Arkansas and other states to reclaim the swamp lands within their limits in 1850. All swamp and overflowed lands received by virtue of said act are declared trust lands. All income derived from trust lands will be applied exclusively to the school fund. All moneys accruing to the state for or in behalf of the State Conservation Commission, except fines and moneys payable to the Reforestation Fund, will constitute the Conservation Fund. No money will be expended from the Conservation Fund except in pursuance of an appropriation by law. Funds accruing to the Conservation Fund from the issuance of hunting and fishing permits will not be diverted for any purposes other than those delineated by the Conservation Commission. A set portion of each permit fee will be used toward acquisition and leasing of public hunting and fishing grounds. Specified moneys received into the Conservation Fund must be expended for forest development and reforestation. (Keith-Florida)
W70-03183

**PREVENTION AND CONTROL OF FLOODS.**
Pa Stat Ann tit 16, sec 5147 (1956).

Descriptors: *Pennsylvania, *Flood control, *Channel improvement, *Local governments, Control, Water control, Abatement, Drainage systems, Flood protection, Floodways, Multiple-purpose projects, Flood routing, Rivers, Streams, Storm drains, Drains, Storm runoff, River basin development, Flow control, Flood forecasting, Flooding, Costs, Economics, Cost sharing, Budgeting.

For the purpose of cleansing, regulating, improving and controlling rivers, streams, and storm drainage systems for the prevention and control of floods, the board of county commissioners may borrow, appropriate and expend money and may acquire real property or any interest therein. The commission may make expenditures to investigate and examine such waters and may seek contribution from the United States or any other state. (Smith-Florida)
W70-03187

**FLOOD CONTROL PROJECTS.**
Pa Stat Ann tit 32, secs 666-672 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Highways, *Reservoirs, Abatement, Check structures, Drainage systems, Flood damage, Flood protection, Flood routing, Control structures, Diversion structures, Flooding, Cities, Local governments, State governments, Federal government, Water resources development, Interstate, Riparian rights, Financing, Easements.

Municipalities and the Department of Highways may agree with the Water and Power Resources Board or federal agencies to relocate roads, streets, bridges, or viaducts to aid any state or federal flood control works. Any state highway becoming flooded, unnecessary, or dangerous because of a flood control reservoir may, with the Governor's approval, be closed by the Secretary of Highways. The Secretary and municipalities may grant easements or flowage rights to the United States to submerge highways, streets, roads and bridges during emergency floods. The Board may accept and operate completed federal flood control works. The rights to waters in a flood control district are limited to those rights in existence before such district was created. Any increase in possible use of these waters is owned by the state. Special financing is provided for, and a flood control fund is created. The Water and Power Resources Board is empowered to cooperate with other states in flood control projects and may delegate certain powers to the federal government. (Smith-Florida)
W70-03192

**NAVIGABLE WATERS AND NAVIGATION IN GENERAL.**
Wis Stat Ann secs 30.10, 30.11 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Navigable waters, *Navigation, *Bulkhead line, Legislation, Legal aspects, Lakes, Streams, Bayous, Harbors, Basins, Canals, Dams, Bridges, Cities, Regulation, Boundaries (Property), Leases, Beds, Riparian rights, Administrative agencies, Resource development, Bridge construction, Construction, Standards.
Identifiers: *Public waters, *Obstructions to navigation, *Riparian owners.

All lakes within the state which are navigable in fact are declared to be navigable and public waters. All steams, sloughs, bayous, and marsh outlets which are navigable in fact are declared navigable to the extent that no dam, bridge, or other obstruction shall be constructed in or over them without the permission of the state. All inner harbors, turning basins, waterways, slips, and canals created by any city for purposes of public navigation and all outer harbors connecting interior navigation with lake navigation are declared navigable waters. The power of cities to construct bridges over streams is not impaired. Boundaries of riparian land and

rights of riparian owners will be determined in conformity with the common law, with specified exceptions. Cities may, subject to the approval of the Department of Resource Development, establish a bulkhead line and change it from time to time. The standards and methods for establishing bulkhead lines are specified. Establishment of a bulkhead line will not abridge the riparian rights of riparian owners. The requisites for leasing by the Department of Public Lands for specified purposes are set forth. (Keith-Florida)
W70-03195

**DIVERSION AND ALTERATION OF WATERCOURSES.**

Wis Stat Ann secs 30.18, 30.19, 30.195 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Diversion, *Artificial watercourses, *Water resources development, Legislation, Legal aspects, Streams, Lakes, Water levels, Riparian land, Riparian rights, Public rights, Surplus water, Permits, Structures, Maps, Surveys, Planning, Channels, Canals, Condemnation, High water mark, Banks, Navigation, Highways, Wildlife conservation, Administrative agencies.
Identifiers: Penalties (Criminal).

The surplus water of any stream may be temporarily diverted in order to restore or maintain the normal water level of any navigable lake or stream. Water, other than surplus water, may be diverted with the consent of riparian owners to be damaged thereby if such diversion is for agricultural purposes and will not be detrimental to public rights. Surplus water means any water of a stream which is not being beneficially used. Before any water may be diverted, a permit must be obtained from the Department of Resource Development. The method for applying for such permits and the conditions on which such permits are granted are set forth. It is unlawful to begin any work designed to connect any watercourse or body of water with any existing navigable watercourse or body of water without first obtaining a permit from the Department of Resource Development. The method of application, requirement for public hearing and conditons under which such permits may be granted are set forth. Criminal penalties are provided for violation of any of the foregoing provisions. It is unlawful to change the course of a navigable stream without first having obtained a permit therefor from the Department pursuant to statute. (Keith-Florida)
W70-03197

**CONSTRUCTION AND MAINTENANCE OF DAMS.**

Wis Stat Ann secs 31.04-31.09 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Dams, *Water control, Cities, Navigable waters, Permits, Damsites, Eminent domain, Construction, Piers, Hydraulics, Recreation, Benefits, Economic justification, Conservation, Public rights, Lakes, Lake shores, Aesthetics, Rivers, Water levels, Height, Property values, Legislation, Electric power production, Operation and maintenance.

Permits to construct, operate, and maintain dams may be granted to persons, corporations, or municipalities pursuant to this law. Written applications for permits contain a general description of the proposed dam, the proposed site, the intended purpose of the dam, and an estimate of the dam's capabilities of producing hydraulic power. The Department of Resource Development shall hold public hearings on applications for permits. The Department shall consider public interest, economic effects, and recreational values when reviewing each application. Scenic beauty has a high priority in this consideration. The Department shall also investigate the potentialities of any lakes and lake shores which would be created by the flowage of proposed dams. The Department shall also weigh the effects of dams upon rivers. If the economic need for electric power is less than the value of recreation and scenic beauty, the Department must deny the permit. Provision is also made for applications for permits to operate existing dams. Procedures for approving such applications are substantially the same as those governing the construction of new dams. (Duss-Florida)
W70-03200

**MAINTENANCE OF DAMS AND DIKES FOR DRAINAGE CONTROL AND CONSERVATION.**
Wis Stat Ann secs 31.36-31.38 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Water conservation, *Drainage, Water control, Ditches, Flow, Rivers, Streams, Lakes, Dams, Dikes, Levees, Breakwaters, Shores, Banks, Right-of-way, Condemnation, Cost sharing, Conservation, Wildlife conservation, Furbearers, Aquatic animals, Birds, Breeding, Construction, Irrigation, Cost allocation, Decision making, Project planning, Cost analysis.
Identifiers: *Pisciculture.

The Water Regulatory Board is created to supervise the operation, repair, and maintenance of dams and dikes constructed across drainage ditches and streams within drainage districts, in the interest of drainage control, water conservation irrigation, and pisciculture. The Board is directed to provide areas suitable for the nesting and breeding of aquatic birds and the propagation of fur-bearing animals. The Board shall operate in cooperation with the various drainage districts throughout the state. Municipalities are directed to furnish the right-of-way for additional levees. Municipalities may authorize the acquisition, construction, maintenance, or repair of dams across any lakes or streams adjoining, or within, the limits of that municipality. After cost estimates of these projects are adopted by the municipality, project plans must be submitted to the Department of Resource Development or to the proper United States officer for approval. The method of cost assessment for improvements is set forth. (Duss-Florida)
W70-03201

**CREATION OF TOWN SANITARY DISTRICTS FOR POLLUTION CONTROL AND WASTE DISPOSAL.**
For primary bibliographic entry see Field 05G.
W70-03203

**CONSTRUCTION, MAINTENANCE AND IMPROVEMENT OF DRAINS.**

Wis Stat Ann secs 88.62-88.73 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Drainage districts, *Maintenance, Maintenance costs, Construction costs, Administrative agencies, Drainage programs, Drainage systems, Budgeting, Cost sharing, Local governments, Water policy, Inspection, Contracts, Assessments, Drains, Legislation, Bridge construction.

A drainage board must maintain the drains of its drainage district and inspect them annually. When funds for maintenance of drains fall below five percent of the benefits of drainage, the boards shall levy assessments for the costs of maintenance and repair. Maintenance does not include the alteration or enlargement of drains. The boards may construct drains across railroad rights-of-way or utility installations. When the construction of a drain across a highway necessitates the reconstruction of a bridge the drainage district involved shall assume the costs of such reconstruction. The district must pay for damage to land outside the district caused by its activities. Where landowners of a district desire more thorough or different drainage and the drainage board determines that public health and welfare will be served, subdistricts may be formed to facilitate drainage. Dams found by the court to obstruct drainage may be removed. The owners of lands assessed for drainage expenses but inaccessible to existing drains may petition to have connecting drains constructed. (Dye-Florida)
W70-03204

**DIVISION OF WATER.**
Ohio Rev Code Ann secs 1521.01 thru 1521.13, 1521.41, 1521.42 (1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Water resources, *Water resources development, *Water management (Applied), Legislation, Legal aspects, Wells, Surface waters, Subsurface waters, Aquifers, Water conservation, Water supply, Water utilization, Planning, Watersheds (Basins), Regulation, Water pollution, Investigations, Hydroelectric power, Flood control, Permits, Surveys, Hydrologic data, Ohio River, Utilities, Watercourses (Legal), Reservoirs, New York State Barge Canal, Dikes, Levees, Dams, Eminent domain, Administrative agencies.
Identifiers: *Salt Fork Lake.

'Water resources' means all surface waters occurring in channels and all subsurface waters occurring in aquifers which are available or may be made available to agricultural, industrial, commercial and domestic users. The Division of Water is created within the Department of Natural Resources. The Division of Water will: (1) collect, study and interpret all available data pertaining to the supply, use, conservation and replenishment of the underground and surface waters of the state; (2) be authorized to perform stream gauging within the state (3) advise the political subdivisions of the state regarding water conservation and ground water recharge; (4) regulate the drilling and operation of wells to prevent subsurface water contamination; (5) conduct a basic inventory of the water resources in each drainage basin within the state and develop a plan for the management of such resources; and (6) investigate flood control problems within the state. Entities engaged in well-digging must keep logs thereof and must furnish copies to the Division. No dam may be constructed without first obtaining a permit from the Division. The Division will control and maintain certain named reservoirs, dams, and canals. The Division will construct, control and manage the Salt Fork Lake project. (Keith-Florida)
W70-03211

**OHIO WATER COMMISSION.**
For primary bibliographic entry see Field 06B.
W70-03212

**PUBLIC UTILITIES (RIGHT OF WAY DRAINAGE AND FENCES).**

Ohio Rev Code Ann sec 4959.01 (Page 1953).

Descriptors: *Ohio, *Railroads, *Ditches, *Surface drainage, Drainage systems, Legislation, Drains, Drainage, Conduits, Drainage engineering, Outlets, Industrial water, Water, Flow, Water distribution, Water control, Swamps.

Except where the roadbed of a railroad contacts a swampland, the railroad must provide ditches or drains along the roadbed sufficient to conduct accumulating water to some proper outlet. (Powell-Florida)
W70-03215

**PERFORMANCE OF TILE DRAINS UNDER IRRIGATION IN SOUTHERN ALBERTA,**
Department of Agriculture, Lethbridge (Alberta); and Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03227

## 4B. Groundwater Management

**OBSERVATIONS ON WATER CONTENT CHANGES IN STRATIFIED SEDIMENTS DURING PIT RECHARGE,**
Arizona Water Resources Research Center, Tucson.
L. G. Wilson.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 23, 1969. 40 p, 10 fig, 2 tab, 21 ref. OSW Grants No 14-01-0001-630 and 14-01-0001-1805.

Descriptors: *Pit recharge, *Sediments, *Flow characteristics, *Arizona, Flow, Alluvium, Basins, Water table, Piezometers, Hydraulic gradient, Drainage, Wells, Observation wells.
Identifiers: *Stratified sediments, Basin-fill stratigraphic units.

Two principal flow regimens were observed during Arizona pit recharge studies in stratified sediments overlying the 80-foot deep water table. The uppermost region was observed near the interface between the alluvium and basin-fill stratigraphic units. The lowermost region was apparent above the water table in materials of the basin-fill unit. Three main stages prevailed in the history of the two flow regimens: development stage, equilibrium stage, and drainage stage. Water content profiles, flow characteristics and piezometer data are discussed for these stages. It is concluded that cyclic recharging is a more effective management technique than continuous inundation in order to maximize recharge volumes. A regeneration of an open surface is apparently promoted by periodic drying periods thus sustaining favorable lateral hydraulic gradients. (Carstea-USGS)
W70-02887

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL,**
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 491-515, May 1953. 25 p, 117 ref.

Descriptors: *Percolating water, *Underground streams, *Subsurface waters, *Confined water, Legislation, Judicial decisions, Reasonable use, Diversion, Wisconsin, New York, Hawaii, California, Water resources, Water policy, Water law, Prior appropriation, Water conservation, State governments, History, Natural gas, Oil, Exploitation, Administrative agencies.
Identifiers: *Common law.

Beginning with its origin in 1843, the author traces the development of the law of underground water. Non-statutory rules are discussed first. These fall into three groups: (1) the English Rule or common law rule; (2) the American Rule or reasonable use rule; and (3) the California Rule or the doctrine of correlative rights. In discussing these and later topics, the author utilizes judicial decisions to reveal the development of the law. Diversions of underground streams and diversions of percolating and artesian waters are treated in separate sections. The effect of malice in relation to underground water law is discussed. A summary of the non-statutory law is included. Various statutory materials are then discussed in relation to the problem of waste. The balance of the paper contains a development of Wisconsin's history in this area. The laws of New York and Hawaii are also discussed. The author concludes that the problem is to find the best method of regulating water for the benefit of the state without doing violence to the rights of private owners. Much of the law is said to be based on erroneous scientific and economic materials. Reference is made to a proposed statute designed to effectuate this policy. (Schram-Florida)
W70-02898

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (STATUTORY MATERIALS),**
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 503-515, May 1953.

Descriptors: *Wisconsin, *Subsurface waters, *Reasonable use, *Diversion, Legislation, Water policy, Water law, Oil, Natural gas, Administrative agencies, Regulation, History, Exploitation, Public rights, Confined water, Water conservation, Percolating water, Water resources, Economics, Well regulations.

Satutory materials relating to waste of underground waters are discussed. Statutes from several states declare that artesian wells must be capped to prevent waste when the water is not being used. One group of states has declared uncapped artesian wells to be a nuisance, with the owner being guilty of a misdemeanor. Wisconsin statutory law is discussed. In Wisconsin liability for waste depends upon whether the owner allowed the well to discharge more water than reasonably necessary and whether such action materially diminished the flow of another well in the vicinity. Various cases distinguishing natural gas and oil from water are discussed. After dealing with the laws in several other states, the author makes some general conclusions. He defines the problem as being the finding of the best method of regulating water without doing violence to the rights of private owners. Many of the extreme methods used today are based upon erroneous scientific and economic materials. The public interest is sufficient to justify legislation to prevent exploitation and waste by the owner of the land under which the water lies. (See W70-02898). (Schram-Florida)
W70-02900

**GENERAL ECONOMIC ASPECTS OF UTILIZATION OF UNDERGROUND WATER FOR IRRIGATION IN HIGH PLAINS OF TEXAS,**
For primary bibliographic entry see Field 03F.
W70-03010

**THE ARTESIAN SYSTEM IN GEORGIA: STRATIGRAPHY AND HYDROLOGY OF THE OCALA,**
Georgia University, Athens, Geology Dept.
Mark Rich, and Edward A. Stanley.
PB-189 041, Partial Completion Report, Georgia Water Resources Center, Nov 1969. 11 p, 6 tab, 20 ref. OWRR Project A-006-GA.

Descriptors: *Stratigraphy, *Paleohydrology, *Petrography, *Limestones, Porosity, Calcareous soils, Sedimentary petrology, Georgia.
Identifiers: *Ocala Limestone, *Little Stave Creek, Alabama, *Rich Hill Section (Georgia), *Coccoliths.

The report summarizes studies of rocks belonging to the Jackson Group in Southwestern Georgia (the Ocala Limestone). The stratigraphy of the Ocala is outlined. Field and laboratory work is documented including petrographic and stratigraphic analysis. Paleontological studies and analyses of the Ocala Limestone indicate that the necessary zonations and correlations could be made on the basis of calcareous nannoplankters. Biostratigraphic zonation of the Alabama Little Stave Creek section based on the distribution of 45 species of Coccolithophores showed three distinct units within the Eocene deposits. Use of nannoplankters in Georgia has been limited by widespread silification of the Ocala exposures. The report indicates that Coccoliths will prove to be useful for future subsurface studies in Georgia when it is known that silification of the Ocala Limestone has not taken place. (Conway-Georgia Tech)
W70-03037

**SUBSURFACE IRRIGATION RESEARCH IN ARKANSAS,**
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03063

**THE CONVOLUTION RELATION AS APPLIED TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 02F.
W70-03064

**WATER AVAILABILITY IN URBAN AREAS OF THE SUSQUEHANNA RIVER BASIN - A PRELIMINARY APPRAISAL,**
Geological Survey, Albany, N.Y.
Robert D. MacNish, Allan D. Randall, and Henry F. H. Ku.
New York Water Resources Commission Report of Investigation RI-7, 1969. 24 p, 15 fig, 6 ref.

Descriptors: *Water management (Applied), *Conjunctive use, *Streamflow, *Induced infiltration, *New York, Hydrographs, Hydrograph analysis, Statistical models, Statistical methods, Water storage, Aquifers, Water reuse, Artificial recharge, Low-flow augmentation.
Identifiers: *Susquehanna River basin, (N Y).

Using the mean of the logs of the monthly average flows, an average annual hydrograph was constructed for major streams in the three largest urban areas in the Susquehanna River basin in New York State. This logarithmic-based average hydrograph more nearly approximates daily flows than an arithmetic-base average hydrograph. Comparison of this hydrograph and the storage potential of local aquifers enables determination of the required volumes of upstream storage, or recycling of treated waste waters and artificial recharge necessary to sustain maximum induced infiltration and pumpage from groundwater storage. The desirability of using treated waste water in artificial recharge or streamflow augmentation is enhanced by the fact that recycling 60 percent of the treated waste water can double water availability for these urban areas. (Knapp-USGS)
W70-03102

**ACCURACY OF WELL DISCHARGE COMPUTATIONS FROM CURVES OF THE DISCHARGE AS A FUNCTION OF THE DROP IN WATER LEVEL (TAKING THE DZHEZKAZGAN REGION AS AN EXAMPLE),**
V. N. Ostrovskiy, and M. A. Khordikaynen.
Transl from Trudy Inst Gidrogeologii i Gidrofiziki, Akad Nauk Kazakhskoy SSR, Vol 1, p 198-201, 1968. Soviet Hydrology: Selected Papers, No 4, p 363-365, 1968. 3 p, 1 tab, 7 ref.

Descriptors: *Wells, *Groundwater movement, *Groundwater recharge, *Karst, Observation wells, Equations, Statistical methods, Specific yield, Water levels, Discharge (Water).
Identifiers: *USSR, Dzhezkazgan.

Pumping tests showed that the ratios between the well discharge and the level of the fissure-karst waters of the Dzhezhazgan region, USSR, are fairly complex. The following formulas were used: (1) The Dupuis for pressureless waters; (2) Krasnopol'skiy; (3) Keller; (4) Smreker; and (5) Al'tovskiy. Statistical analysis showed that: (1) Keller's parabolic relationship gave the most accurate results for prospecting wells; (2) Keller's formula was also best suited for computations of the specific discharges of prospecting and operational wells. Further discussion of other formulas is presented. (Carstea-USGS)
W70-03114

**A REVIEW AND REVITALIZATION: CONCEPTS OF GROUNDWATER PRODUCTION AND MANAGEMENT--THE CALIFORNIA EXPERIENCE,**
University of Southern California, Los Angeles. School of Law.
Robert I. Reis.
Natural Resources Journal, Vol 7, p 53-87, No 1, Jan 1967. 67 ref.

Descriptors: *Groundwater basins, *Legal aspects, California, Judicial decisions, Administrative agencies, Storage, Water supply.
Identifiers: Groundwater management.

The nature of legally protected interests in groundwater production must be redefined. In California, judicial allocation of water resources traditionally has been based on a limited natural supply. Imported water, by increasing the supply, brings this judicial approach into question. The most efficient method of meeting water requirements would be to pipe in imported water at a constant rate equal to base requirements, and to use the basin as a storage facility for peaking and cyclic needs. This method requires conceptual recognition of the basin as a place of storage. Section I highlights the evolution by which California water rights cases have projected protection of the basin's storage qualities. Three cases are analyzed in detail. Section II discusses the problems left unanswered by use of settlement agreements. Section III offers organizational alternatives for correcting settlement practices. Alternatives include open market allocation, regulatory controls, and state ownership and control. Private settlements have provided optimal conditions in the past, but future problems require coordinated dispensation of all available water source and storage facilities. Only a central agency can serve this need. (Gossen-Chicago)
W70-03145

**SUBSURFACE AND PERCOLATING WATERS - WELL DRILLING.**

N J Stat Ann secs 58:4A-1, 58:4A-2, 58:4A-4 to 58:4A-4.3 (1966) N J Stat Ann secs 58:4A-5, 58:4A-6, 58:4A-13, 58:4A-14, 58:4A-20 (Supp 1968).

Descriptors: *New Jersey, *Subsurface waters, *Well regulations, *Well permits, Legislation, Percolating water, Water resources, Administrative agencies, Regulation, Wells, Drilling, Legal aspects, Diversion, Withdrawal.
Identifiers: *Well sealing, Penalties (Civil).

A permit must be obtained from the Division of Water Policy and Supply of the State Department of Conservation to divert water from subsurface or percolating sources in excess of 100,000 gallons per day in areas delineated by said division where such diversion threatens to exceed the natural replenishment of such waters. Existing diversion of water at the time of this act or of the delineation of an area may be continued without a permit. Abandoned wells must be sealed and filled. The Division may order such sealing, and enforce such an order and any provisions of this act in the superior court. No person, partnership or corporation shall drill a well unless he is a licensed well driller. Operations on the drilling or construction of wells shall be under the immediate supervision of a licensed well driller. No well shall be drilled without a permit as required by this act. A report to the Department must be filed giving a description of wells drilled. The Division shall have power to investigate and inspect the construction and repair of wells throughout the state. Violations of this act are punishable by a fine of $100 to $250. (Sisserson-Florida)
W70-03180

**GROUNDWATER RECHARGE THROUGH MODIFIED SHAFTS,**
Agriculture Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
D. C. Signor, V. L. Hauser, and O. R. Jones.
American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 486-489, 1969. 8 fig, 21 ref.

Descriptors: *Shafts (Excavations), *Groundwater recharge, *Aquifers, *Groundwater mining, *Recharge wells, Irrigated land, Groundwater, Surface runoff, Water table, Water resources, Agriculture, Evaporation, Piezometry, Overdraft, Hydraulic mining, Sands, Irrigation, Water quality, Turbidity, Texas, Playas, Drawdown.

Groundwater mining for irrigation from the Ogallala Formation under west Texas has caused serious decline in the water table - a common problem in arid and semiarid regions. Surface runoff from about 90% of the high plains of Texas, accumulating in natural depressions and playas, amounts to 2.5 to 3.0 million acre feet per year lost to evaporation. If this water could be diverted to recharge the aquifer, the agricultural life of the area could be prolonged and a reduced area of irrigated agriculture supported indefinitely. The authors report an experiment in which shafts were dug into the aquifer under a playa to recharge the aquifer. Observation wells and piezometers were also located in the area. Recharge rates through plain shafts ranged from 90 to 220 gallons per minute. A shaft modified by hydraulically mining a cavity deep in the aquifer sands increased recharge with clear water to 788 gallons per minute-a rate considered satisfactory. Some trouble was encountered with entrapped air at high recharge rates. It was also concluded that muddy water would have to be clarified before recharge to prevent aquifer surface plugging. The study has not continued long enough to determine what effects there may be from groundwater mounding under a recharge well. (Crouse-Arizona)
W70-03228

**CONTRIBUTIONS ON THE STATUS OF ARID-LANDS RESEARCH: GROUNDWATER IN AUSTRALIA,**
Arizona Univ., Tucson; and Army Natick Labs., Mass. Earth Sciences Div.
Eugene S. Simpson.
US Army Natick Laboratories, Earth Sciences Laboratory, Technical Report 70-5ES, 1969. 22 p, 52 ref. Contract No DAAG 17-67-C-0199.

Descriptors: *Arid lands, *Groundwater, *Groundwater basins, *Geologic investigations, *Rocks, Semiarid climates, Groundwater recharge, Groundwater reservoirs, Confined water, Hydrogeology, Geologic time, Mineral waters, Irrigation, Irrigation water, Crystalline rocks, Limestones, Sandstones, Sedimentary rocks, Groundwater mining, Wells logging (Recording), Sands, Aquifers.
Identifiers: *Australia, Porous rocks.

Since most of Australia is arid or semiarid, groundwater becomes extremely important. There is detailed knowledge of groundwater for small areas of the country, but for the most part the groundwater resources are known in only a very general basin-wide level. This report reviews the geology of Australia from the standpoint of aquifer characteristics of the rock structures. Water bearing rocks fall into three categories: (1) unconsolidated sediments, (2) porous rocks, and (3) fractured rocks. Most of the usable groundwater in arid Australia is contained in pore spaces of sandstones and limestones occurring in sedimentary basins which cover about one-half of the arid zone. These structures tend to be flat lying and are hundreds to thousands of feet in thickness, but are inter-layered with relatively impervious materials. This tends to produce artesian conditions in some places. The stored water has accumulated over geologic time and although great in quantity, is probably not being recharged at the rate of withdrawal for irrigation, livestock watering and domestic use. At least half of the groundwater supply is too mineralized for irrigation. In areas of crystalline rocks there are modest supplies of groundwater in the fractures or thin surface deposits of unconsolidated material. (Crouse-Arizona)
W70-03229

## 4C. Effects on Water of Man's Non-Water Activities

**SALTWATER INTRUSION IN THE UNITED STATES,**
American Society of Civil Engineers, New York. Hydraulics Div.
C. B. Sherwood, A. E. Bruington, and W. J. Drescher.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1651-1669, Sept 1969. 19 p, 1 tab, 7 ref, append.

Descriptors: *Encroachment, *Saline water intrusion, Groundwater, Salt water barriers, United States, *Saline water, Aquifers, Injection wells, Saline water-freshwater interfaces, Groundwater geology, Brine disposal, Underground water storage, *Salinity, *Sea water, Contamination, Brines, Water wells, Fresh water.

Salt-water intrusion into fresh groundwater formations is almost always the inadvertent result of some activity of man working to improve his environment. Three general mechanisms by which intrusion occurs are: (1) the reversal or reduction of groundwater gradients, allowing heavier saline water to move into an underground area where only fresh water existed before; (2) the accidental or inadvertent destruction of natural barriers that formerly prevented movement of salt waters or separated bodies of fresh and salt water; and (3) the accidental or inadvertent result of disposing of waste saline water. The occurrence of saline water is described in terms of geologic and hydrologic conditions. The extent of salt-water intrusion is given using a listing of 68 examples from throughout the United States. Statements are included regarding some areas where major control efforts are underway. (USBR)
W70-02940

**A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,**
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03035

**EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,**
Agricultural Research Service, Coshocton, Ohio. Corn Belt Branch.
For primary bibliographic entry see Field 03B.
W70-03088

**PROBLEM OF ALLOWING FOR THE INFLUENCE OF AGRICULTURAL MELIORATION PRACTICES ON FLOW IN THE CONSTRUCTION OF A GENERAL PLAN FOR THE UTILIZATION AND PROTECTION OF THE WATER RESOURCES OF THE USSR,**
B. B. Leont'yevskiy.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 58-66, 1968. Soviet Hydrology: Selected Papers, No 4, p 374-380, 1968. 3 tab, 12 ref.

Descriptors: *Water resources, *Water level fluctuations, *Agricultural watersheds, Watersheds (Basins), River flow, Forest management, Soil management, Soil conservation, Steady flow, Water management (Applied), Water conservation.
Identifiers: *USSR.

Two main opposing concepts regarding the influence of agricultural melioration practices on river flows are critically evaluated. These concepts are: (1) Agricultural and forest melioration practices do not reduce the normal flow to any significant extent; (2) the practices will change the water balance of the steppe and forest-steppe zones and the normal flow will decrease substantially. American data on the subject from the Mill Creek, Ohio, suggest that agricultural practices and an increase in yield will probably have no significant effect on the normal flow of large and medium rivers. More research in this field is strongly recommended. (Carstea-USGS)
W70-03110

**CONSTRUCTION OF STATE HIGHWAY WHICH RESULTS IN DESTRUCTION OF WELL USED FOR POTABLE WATER SUPPLY.**

NJ Stat Ann secs 27:7-21.1, 27:7-21.2 (1968-69 Supp).

Descriptors: *New Jersey, *Wells, *Highways, *Replacement costs, Cost repayment, Compensation, Costs, Cost sharing, Payment, Government supports, Construction costs, Reimbursable costs, Highway effects, Road construction, Water wells, Legislation, Legal aspects, Potable water.

Where a well providing an adequate supply of potable water is destroyed by the construction of a state highway and the construction of a new well is necessitated, the State Highway Commissioner may pay the owner of the well such portion of the cost of a new well as the Commissioner deems just or the cost of extending an existing municipal or private water main to the affected property. Payment is made only if a new well is actually constructed, and such payment shall never exceed the cost of construction. (Dye-Florida)
W70-03219

## 4D. Watershed Protection

**MISSISSIPPI WATER RIGHTS LAW,**
For primary bibliographic entry see Field 06E.
W70-02897

**ACQUISITION OF LAND FOR PUBLIC RECREATIONAL PURPOSES - WATERSHED PROTECTION AREAS.**
Wis Stat Ann secs 60.18 (15), 60.18 (21) (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Watershed management, *Water resources, *Dam construction, Land, Legal aspects, Dams, Rivers, Recreation, Conservation, Natural resources, Land resources, Costs, Bodies of water, Public benefits, Financing, Local governments, Recreation facilities, Lake shores, Legislation.

At any annual town meeting the qualified electors may vote to authorize the town board to acquire land, river fronts, and lake shores for public use to construct and maintain dams within such tracts for recreational purposes, and to raise and expend money in developing watershed protection areas. (Casey-Florida)
W70-02913

**SOIL CONSERVATION DISTRICTS LAW.**
Ark Stat Ann sec 9-902 (1956), as amended, (Supp 1967).

Descriptors: *Arkansas, *Erosion control, *Erosion, *Soil conservation, Water loss, Legislation, Legal aspects, Soil erosion, Silting, Sedimentation, Streams, Channels, Reservoirs, Dams, Ditches, Harbors, Wildlife conservation, Navigation, Irrigation, Flood control, Water resources development, Land use.
Identifiers: Subsurface water loss, Corrective methods, Desilting basins.

Improper land-use practices continue to cause serious land erosion by water and wind. The consequences of such soil erosion include the silting and sedimentation of stream channels, reservoirs, dams, ditches, and harbors. Further consequences include water loss, fish loss, flooding, diminishing of the underground water reserve, and losses in navigation, municipal water supply, and irrigation developments. The corrective methods to conserve soil resources and prevent erosion include: appropriate soil conservation and land-use practices; structures for flood prevention, water development and conservation; construction of terraces, check dams, desilting basins, channel improvements, ponds and ditches; land drainage; land irrigation, the storage, transportation, and sale of water for irrigation, municipal or industrial water supply purposes; and a rural domestic water supply system. It is the policy of the legislature to provide for the foregoing corrective methods in order to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, and to accomplish other purposes. (Keith-Florida)
W70-02945

**THE BENEFITS FROM WATERSHED DEVELOPMENT,**
Soil Conservation Service, Washington, D.C.; Tennessee Valley Authority, Knoxville; and North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 06B.
W70-03018

**APPLYING ECONOMIC PRINCIPLES IN WATERSHED PLANNING,**
Department of Agriculture, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-03019

**ORGANIZATION FOR WATERSHED PLANNING IN THE PUBLIC INTEREST,**
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 06B.
W70-03020

**MULTIPLE PURPOSE LAND AND WATER DISTRICTS IN ONTARIO,**
University of Western Ontario, London.
For primary bibliographic entry see Field 06B.
W70-03022

**WATER, EARTH AND MAN: 3. HUMAN USE OF GROUNDWATER,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-03095

# 05. WATER QUALITY MANAGEMENT AND PROTECTION

## 5A. Identification of Pollutants

**RADIOTRACER PROCEDURES FOR MECHANISTIC STUDIES IN AIR POLLUTION RESEARCH,**
Bureau of Mines, Washington, D.C.
M. L. Whisman, and Basil Dimitriades.
Bur of Mines Report of Investigations Report RI-7304, Oct 1969. 36 p, 3 fig, 14 tab, 12 ref, 5 append.

Descriptors: *Air pollution, *Water pollution sources, *Radioactivity, *Tracers, *Smog, Trace elements, Atmosphere, Carbon, Statistical methods, Analytical techniques.
Identifiers: *Photochemical reactions (Smog).

Radiotracer techniques were developed for stoichiometric studies of photochemical reactions associated with atmospheric smog formation. Stock blends of separate hydrocarbon and oxygenated compounds were prepared and calibrated. C-14-labeled reactants and products in reaction systems involving hydrocarbons and nitrogen oxides at the ppm level were analyzed for qualitative and quantitative data. These methods developed for preparation and calibration of gas phase blends at a level of about 1000 ppm are applicable to low-molecular weight material (ethylene, butene) and to high-boiling materials such as m-xylene and mesitylene. Analytical methods developed for quantitative measurement of radioactivity products show the estimated precision level, with the exception of formaldehyde, plus or minus 2 percent. (Gabriel-USGS)
W70-02875

**A REVIEW OF CHEMICAL MEASUREMENTS IN WATER POLLUTION CONTROL,**
Federal Water Control Administration, Washington, D.C. Div. of Pollution Surveillance.
D. G. Ballinger.
Water and Sewage Works, p R38-R40, R42, 1968. 8 tab, 3 ref.

Descriptors: *Analytical techniques, *Water pollution control, *Water quality, Aquatic life, Chemical properties, Domestic water, Fish, Industrial water, Irrigation water, Livestock, Pesticides, Wastes, Wildlife, Water criteria.
Identifiers: Pollution parameters, Public water supply, Water quality parameters.

Selection of chemical parameters for use in evaluating water quality is discussed in relation to the desired water usage. Parameters required for fish, aquatic life and wildlife protection, and those necessary in the evaluation of waste loads are also reviewed. (Chalk-Wisconsin)
W70-02984

**CLAY MINERAL STABILITY AND WATER COMPOSITION,**
Washington State Univ., Pullman.
J. A. Kittrick.
Final Report for FWPCA Grant 16060 DGK, Nov 1969. 7 p, 1 fig.

Descriptors: Free energy, *Clay minerals, Soil chemistry, Soil water, Phase diagrams, Weathering, *Montmorillonite, *Illite.
Identifiers: Soil mineralogy, Soil solution, *Vermiculite, *Mineral.

The application of solubility methods to determining the standard free energy of formation of several soil minerals is summarized. Each of three illites and two vermiculites were found to be unstable relative to other minerals that form in the solution environment of soils and sediments. Illite may form in the ocean where muscovite is stable. Vermiculite derived from trioctahedral micas appears to be merely an unstable intermediate in all natural waters. Each of two montmorillonites were stable in water of specific compositions, as illustrated by a stability diagram. It is evident that minerals and the waters they contact interact to control aspects of each others composition.
W70-03026

**EVALUATION OF WATER QUALITY TRENDS, SHENANDOAH RIVER, VIRGINIA, FRONT ROYAL TO BERRYVILLE,**
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
John W. Baumeister.
Federal Water Pollution Control Administration, Middle Atlantic Region Technical Report 2, Dec 1968. 14 p, 5 fig, 5 tab, 20 ref.

Descriptors: *Water quality, *Water pollution, *Rivers, Water chemistry, Water pollution sources, Phosphorus, Nitrogen compounds, Eutrophication, Productivity, Algae, Aquatic life.
Identifiers: Shenandoah River.

Physical and chemical data collected at the Berryville Surveillance Station were evaluated to determine pollution and eutrophication trends in the main stem of the Shenandoah downstream from Front Royal. Chemical quality was within the raw water criteria established for public water supplies; however, total phoshorus and nitrogen content of river water was sufficiently high to indicate a fertile stream capable of producing abundant aquatic organisms. Thirteen years of bottom samples collected over a 30 yr period in this reach show a gradual increase in the productivity of aquatic invertebrates. For the most part, these samples contained clean water and facultative forms which indicate the presence of relatively clean water. Phytoplankton numbers and population composition during the period 1962-1965 indicate a change from a diatom dominated population to one dominated by green algae. Nuisance algae were not

present in quantities sufficient to cause water treatment problems. (Knapp-USGS)
W70-03068

**POLLUTION OF WATER BY MINERAL OIL; GAS CHROMATOGRAPHIC DETERMINATION OF OIL TRACES IN WATER (DUTCH),**
R. Jeltes.
English summary. H2O, Vol 2, No 17, p 403-405, Aug 21, 1969. 3 p, 2 fig, 1 photo, 12 ref.

Descriptors: *Pollutant indentification, *Oily water, *Gas chromatography, Analytical techniques, Surface waters, Groundwater, Oil wastes, Industrial wastes.
Identifiers: Oil waste identification.

Contamination of surface and groundwater with mineral oil products is a matter of growing concern. This type of contamination may be detrimental for the quality of drinking water prepared from such waters. In the investigation of these pollutants, analytical chemical methods of determination are necessary. Attention is given principally to the determination of oil components in true solution (aromatic hydrocarbons), which are most detrimental. The method described is based on extraction of the oil from water and subsequent gas chromatographic analysis of the resulting extracts. Determination of the origins of oil components in water appears to be possible in certain cases. The method developed has been applied in the laboratory and in the field. (Knapp-USGS)
W70-03085

**SOME PROBLEMS CONCERNING THE THERMAL REGIME OF RIVERS IN THE ARAKS BASIN,**
S. M. Musayelyan.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 177-184, 1968. Soviet Hydrology: Selected Papers, No 4, p 408-414, 1968. 4 fig, 4 tab, 4 ref.

Descriptors: *Thermal pollution, *Water temperature, Gaging stations, Rivers, Watersheds (Basins), Heat flow, Air temperature, Hydrologic properties.
Identifiers: *USSR, Araks basin, Thermal regime.

The water temperature was measured at 67 gaging stations in the Araks River basin, USSR between 1950 and 1962. The data were used to determine: (1) the major patterns and characteristics of river water temperature, (2) annual and daily variation, (3) duration of periods of water temperature gradations, and (4) the heat flux. Two types of thermal regime can be distinguished: (1) Type I includes most of the rivers of the region and is characterized by water temperature variations as a function of air temperature; (2) Type II in which the thermal regime is affected by air temperature and by hydrogeological conditions of river feeding. There is a single maximum and a single minimum in the daily river water temperature. The water temperature increases along the rivers and the variations are significant along large rivers. (Carstea-USGS)
W70-03112

**LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.**
Illinois State Sanitary Water Board, Springfield.

Illinois State Sanitary Water Board, Report to the Governor and 76th General Assembly, Apr 1969. 36 p, 6 fig, 15 tab, 6 ref.

Descriptors: *Water quality, *Lake Michigan, *Illinois, *Water pollution, Coliforms, Bacteria, Phenols, Chlorides, Hydrogen ion concentration, Sulfates, Turbidity, Radioisotopes, Ammonium compounds, Nitrogen compounds, Phosphates, Lake beds, Pollution abatement.

During 1968, Illinois State Sanitary Water Board staff monitored Lake Michigan open water. Bottom samples were collected from a boat using sampling dredges. Results of chemical, bacteriological, phytoplanktor and physical examinations were compared to the Department of Interior Water Quality Standards approved in January 1968. Lake Michigan open water quality was judged to be in general compliance with the criteria for coliform bacteria, fecal streptococci bacteria, phenol-like substances, cyanide, chlorides, sulfates, pH, flourides, filterable residue, turbidity and radionuclides. Criteria for ammonia-nitrogen, phosphates, dissolved iron, and methylene-blue-active-substances were exceeded frequently at all of the intakes. Limited sampling and examination of bottom deposits and organisms indicated general compliance with the criteria, except within the breakwater at Calumet harbor and at the North Chicago sewage treatment works outfall. Action is being taken by the Illinois Sanitary Water Board, in conjunction with the other Lake Michigan states participating in two current Federal Enforcement Conferences, to further abate and to control pollution of the lake by discharges from municipal sewer systems, industries, watercraft and other sources. (Davis-Chicago)
W70-03140

## 5B. Sources of Pollution

**ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,**
Michigan State Univ., East Lansing. Coll. of Engineering.
Marvin E. Stephenson, and Raymond Rodrigue.
Available from the Clearinghouse as PB-188 961, $3.00 in paper copy, $0.65 in microfiche. Michigan State University Institute of Water Research, Completion Report, Apr 1969. 135 p, 10 fig, 1 tab, 87 ref, 3 append. OWRR Proj No A-22-MICH.

Descriptors: *Nitrates, *Adsorption, *Clays, *Soil chemistry, Thermodynamics, Path of pollutants, Laboratory tests, Expansive clays, Montmorillonite, Waste disposal, Water treatment, Anion adsorption, Ions, Ion exchange, Cation adsorption.
Identifiers: Nitrate adsorption.

The interaction of nitrates from agricultural waste disposal and other sources with soil materials was studied by equilibrating 200 solutions of nitrates with coarse-size Na and K montmorillonite particles. The literature on the physiological and chemical effects of nitrates is extensively reviewed and a bibliography is included. In the adsorption experiments, the equilibrium pH increased with increasing clay content. Increasing the nitrate concentration up to 32 mg/l caused an increase in the equilibrium pH when the average pH was greater than 8.9 and a decrease when the average pH was less than 8.9. Between 6 deg C and 35 deg C, nitrate anions, in the presence of either Na or K, were repelled from the surfaces of coarse montmorillonite particles whenever the equilibrium nitrate concentration was less than 20 mg/l and the equilibrium pH was between 4.5 and 10.2. Increasing the nitrate concentration reversed the initial increasing trend of the negative adsorption isotherms. (Knapp-USGS)
W70-02843

**QUALITY OF WATER IN CHICKAMAUGA RESERVOIR.**
Tennessee Valley Authority, Chattanooga. Environmental Hygiene Branch.

Stream Sanitation Staff Report, July 1964. 64 p, 24 fig, 8 tab, appendix.

Descriptors: *Recreation wastes, *Water pollution sources, Water pollution effects, Industrial wastes, Municipal wastes, Pollutant identification, Chemical analysis, Radioactivity, Water quality, Radioactive wastes, Recreation, Strontium, Ruthenium, Cesium, Cobalt, Reservoirs.
Identifiers: Marine craft pollution, Fecal coli, Non-fecal coli, Coliforms, Oak Ridge Atomic Plant, Clinch River (Tenn), Drinking water.

Water quality surveys of this 54 square mile reservoir revealed a significant correlation between discharge of industrial and domestic wastes and density of coliaerogenes, varying from less than 30 to many thousand organisms per 100 milliliter of water--far above drinking water standards. In most parts of the basin, fecal coli comprise a fraction of 1% of total number of coliforms, but the ratio constantly narrows by sewage discharged from towns and marine craft. Sanitary-chemical analyses of water quality included temperature, dissolved oxygen, biochemical oxygen demand, color, odor, and turbidity. Complete analyses of mineral composition were made during one year at monthly intervals. Reservoir receives fractions of the volume of certain low-level radioactive wastes discharged by the Oak Ridge Atomic plant into Clinch River, consequently determinations were made of the radionuclide concentration. Until November 1962, concentration of both cesium-137 and cobalt-60 was below detection limits. Average concentrations of strontium-90 and ruthenium-106 were below maximum allowable level, but in some weeks concentrations of either radionuclide exceeded permissible limits for drinking water. (Wilde-Wisconsin)
W70-02970

**AGRICULTURAL CHEMICALS AND OUR WATER RESOURCES,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Entomology.
E. J. Monke, J. E. Fahey, and P. R. Goodrich.
Available from the Clearinghouse as PB-189 088, $3.00 in paper copy, $0.65 in microfiche. Paper presented at 1968 Annual Meeting of American Society for Engineering Education, California University, Los Angeles, June 17-20, 1968. 17 p, 36 ref. OWRR Proj No A-005-IND.

Descriptors: *Water pollution sources, *Water pollution effects, *Regulation, *Agricultural chemicals, *Reviews, Bibliographies, Pesticides, Fertilizers, Organic matter, Nutrients, Eutrophication, Nitrogen compounds, Legislation, Farm management, Land management.
Identifiers: Agricultural effects (Water quality).

Literature pertaining to the effects of agricultural chemicals on water resources was reviewed. An attempt is made to put the contribution of chemicals from agricultural sources in proper perspective and to predict the effect of increasing regulation on the use and methods of application of agricultural chemicals. Proper management of agricultural chemicals from profit and safety motives alone would reduce the levels of unwanted chemicals reaching water supplies. Much greater research effort is needed in all phases of pollution reduction. In general, engineering education should be more concerned with the environment, its measurement and control. (Knapp-USGS)
W70-03065

**TEMPERATURE AND TURBULENCE EFFECTS ON THE PARAMETER (DELTA) IN THE STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,**
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center; Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering; and Virginia Polytechnic Inst., Blacksburg. Dept. of Statistics.
For primary bibliographic entry see Field 05C.
W70-03066

**EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,**
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk, and Leonard J. Eder.
Proc, Sixteenth Southern Water Resources Pollut Contr Conf, Duke Univ, p 33-54, Apr 1967. 22 p, 11 fig, 3 tab.

Descriptors: *Water quality control, *Mathematical models, *Simulation analysis, *Biochemical ox-

ygen demand, *Dissolved oxygen, Waste disposal, Waste assimilative capacity, Flow augmentation, Alternative costs, River basins, Temperature, Economics, Standards, Evaluation.

A river of approximately 170 miles in length, with a drainage area of 3,500 square miles was studied. The objectives of the study included; (a) determination of the river's physical characteristics; (b) development of a mathematical simulation model of the river to predict the biochemical oxygen demand (BOD) and dissolved oxygen (DO) profiles under any condition of flow temperature or waste discharges; (c) application of the simulation model to investigate in detail the BOD assimilation capacity under critical weather and flow conditions and the effects of sludge deposits, hydroturbine venting and flow augmentation and; (d) development of the comparative economics of alternative solutions for achievement of proposed water quality standards. The river model was used for the development of the effects on water quality anticipated from the solution components available as well as combination of solutions which appeared practical and economically attractive. (Thiuri-Cornell)
W70-03165

**WATER QUALITY PLANNING IN THE PRESENCE OF INTERACTING POLLUTANTS,**
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
Benjamin C. Dysart, III.
42nd Annu Conf, Water Pollut Contr Federation, Dallas, Texas, Oct 1969. 39 p, 18 fig, 2 tab, 15 ref.

Descriptors: *Mathematical models, *Optimization, *River basins, *Water pollution control, *Dissolved oxygen, Temperature, Decision making, Planning, Management, Economic feasibility, Water quality, Standards.

A mathematical optimization model was developed and used to; (a) demonstrate a methodology for water quality planning and management for the interaction of pollutants in the stream, and (b) to minimize total river basin pollution control costs associated with maintaining specific dissolved oxygen (DO) and temperature standards. The Chattahoochee River basin was studied. The study showed that optimal system cost would be most effected by changes in DO standards. Very high DO would be economically prohibitive decreases in temperature standards would be relatively inexpensive. Increases in temperature standards would result in only slight savings for abatement facilities. This type of economic analysis made it possible to compare alternative sets of water quality standards on a common, rational basis for cost affectiveness. It also provided guidance to policy makers. (Thiuri-Cornell)
W70-03168

**CONTROL OF WATER QUALITY IN A COMPLEX NATURAL SYSTEM,**
Clemson Univ., S.C. Dept. of Environmental Systems Engineering; and Georgia Inst. of Tech., Atlanta.
Benjamin C. Dysart, III and William W. Hines.
IEEE Syst Sci Cyberneties Conf Rec, Phila, p 70-81, Oct 1969. 12 p, 9 fig, 3 tab, 18 ref.

Descriptors: *Water quality control, *Dynamic programming, *Biochemical oxygen demand, *Dissolved oxygen, *Temperature, Constraints, Streams, Thermal pollution, Organic wastes, Systems analysis, Water quality, Standards.

An approach to water quality control was presented for the case where there would be significant interaction of wastes in a stream. In most previous studies, a single pollutant was considered and a single related parameter used as a constraint. The specific pollutants selected for study in the investigation were; (a) biochemical oxygen demand (BOD ) and (b) thermal wastes or heat. The related water quality standards were (a) dissolved oxygen concentration (DO), (b) maximum allowable stream temperature, and (c) allowable use in stream temperature. The Chattahoochee River, a free flowing stream which receives thermal and organic wastes was modeled as an N-stage serial system. Two-dimentional dynamic programming technique was used to determine minimum-cost control policies. The response of total system cost and control policy to variation of quality standards was presented. (Thiuri-Cornell)
W70-03170

**TRANSPORT OF DISSOLVED WASTES IN RIVERS,**
Federal Water Pollution Control Administration, Washington, D.C.; and Texas Univ., Austin. Center for Research in Water Resources.
Roger Don Shull, and Earnest F. Gloyna.
J Sanit Eng Div, ASCE, Vol 95, No SA6, p 995-1012, Dec 1969. 18p, 9 fig, 9 ref, 1 append.

Descriptors: *Mathematical models, *Simulation analysis, *Stochastic processes, *River systems, *Environmental affects, Sorption, Digital computers, Channel flow, Downstream, Flow measurement.
Identifiers: Waste transport, Waste release.

Transport of dissolved radioactive and other tonic wastes was simulated on a digital computer for demonstrating possible environmental effects of wastes discharged to rivers in low concentrations over several decades. The mathematical model was based on experimental aquarium and river model data which was sealed to prototype parametric values. Waste transport in large unregulated rivers was simulated over long distances for periods of many years. River simulation included monthly stochastic flow variation flooding, variable channel shape, tributary flow, sorption of wastes by stationary components of the benthal systems, and erosion of the benthal at high flows. Large variations in downstream waste transport rates in river receiving a constant, continious waste release were shown to be a function of channel sorption of wastes, flow variability, and benthal erosion resistance. (Thiuri-Cornell)
W70-03174

## 5C. Effects of Pollution

**MICRONUTRIENT REQUIREMENTS FOR GREEN PLANTS, ESPECIALLY ALGAE,**
Charles F. Kettering Research Lab., Yellow Springs, Ohio.
Clyde Eyster.
Algae and Man, Jackson, Daniel F, editor, Plenum Press, NY, p 86-119, 1964. 11 fig, 2 tab, 174 ref.

Descriptors: *Nutrient requirements, *Plant growth, *Algae, Elements (Chemical), Chlorophyta, Cyanophyta, Chlorella, Manganese, Photosynthesis, Oxygen, Carbon dioxide, Scenedesmus, Chlorophyll, Iron, Chelation, Enzymes, Chlorine, Light intensity, Nitrate, Euglena, Calcium, Ammonium salts, Nitrogen fixation, Boron, Azotobacter, Molybdenum, Cobalt, Copper, Sodium, Magnesium, Potassium, Sulfur, Phosphorus, Hydrogen.
Identifiers: Macronutrients, Micronutrients, Chlorella pyrenoidosa, Autotrophic growth, Heterotrophic growth, Ankistrodesmus, Nostoc muscorum, Scenedesmus obliquues, Scenedesmus quadricauda, Porphyridium cruentum, Lemna minor, Photophosphorylation, Vanadium, Zinc, Euglena gracilis, Anabaena cylindrica, Bacillus subtilis, Aspergillus oryzae niger, Silicon, Phanerogams.

Five elements, manganese, iron, chlorine, zinc, and vanadium are generally required by algae and green plants for photosynthesis. Manganese and chlorine have a role in oxygen evolution. Vanadium accelerates photosynthesis under high light intensity but this effect has been reported only for Scenedesmus obliquus and Chlorella. Iron is the metal part of at least two plant cytochromes which occur in the chloroplasts of green cells and probably facilitates transfer of electrons during photosynthesis. Role of zinc in photosynthesis is uncertain; it may aid in hydrogen transfer since sinc is known to be the metal constituent of various dehydrogenases. Nitrogen fixation in algae having the capacity to fix gaseous nitrogen, requires the following elements: boron, calcium, iron, molybdenum, and perhaps cobalt; these elements may be required for one or more other functions. Critical concentration of an element for its two or more functions is usually much higher for nitrogen fixation. Algae which are forced to fix nitrogen have high boron and calcium requirements. Place of cobalt utilization is uncertain. Some evidence indicates that small concentrations of manganese, calcium, boron, cobalt, copper, and silicon are required for other metabolic functions. (See Vol 2, No 19, Field 5C, entry W69-07832). (Jones-Wisconsin)
W70-02964

**ENVIRONMENTAL CONDITIONS AND THE PATTERN OF METABOLISM IN ALGAE,**
Westfield Coll., London (England). Dept. of Botany.
G. E. Fogg.
Algae and Man, Daniel F. Jackson, editor, Plenum Press, NY, p 77-85, 1964. 22 ref.

Descriptors: *Algae, *Metabolism, *Environments, Variability, Chlorella, Carbon, Temperature, Light intensity, Nutrient requirements, Nitrogen, Nitrogen fixation, Photochemical, Carbon dioxide, Synthesis, Enzymes, Chlorophyta, Rhodophyta, Scenedesmus, Chlamydomonas, Ecology, Phosphorus, Sulphur, Hydrogen ion concentration, Time.
Identifiers: Botryococcus braunii, Metabolic pattern, Anabaena cylindrica, Glycolysis, Tricarboxylic acid cycle, Autoradiography, Monodus subterraneus, Navicula pelliculosa, Xanthophyceae, Bacillariophyceae, Nitzschia palea, Myxophyceae, Chlamydomonas moewussi, Fat accumulation.

A single strain of algal specie may show remarkable variations in intensity and pattern of its metabolic activities, depending on exposure conditions. Effects of light intensity, temperature, and hydrogen ion concentration on rates of individual metabolic processes and on their final growth in cell numbers are known, yet the differential effects that these conditions may have on different processes are largely unknown. Time factor is significant; temperature changes may produce marked alterations in the balance of major anabolic algal processes. Availability of metabolites may affect metabolic pattern, apart from changes on overall metabolic rate. In algal populations growing exponentially, synthesis of proteins and other protoplasmic constituents predominate and directly utilize intermediates of the photosynthetic carbon cycle. A similar effect is perhaps involved in excretion of glycolic acid from photosynthesizing cells. Algae is able to produce adaptive enzymes and metabolic pattern is determined primarily by relative activities of the various enzyme systems. It is unclear whether fat accumulation in nitrogen-deficient cultures results from halting of the developmental cycle at a point at which fat synthesis predominates. Factors affecting fat accumulation are discussed. (See Vol 2, No 19, Field 5C, entry W69-07832). (Jones-Wisconsin)
W70-02965

**A PRELIMINARY BIBLIOGRAPHY ON EXTENT AND CAUSES OF EARLY MORTALITY IN FRESHWATER FISH (DIADROMOUS FISHES EXCLUDED),**
Utah State Univ., Logan. Utah Cooperative Fishery Unit.
Robert H. Kramer.
Food and Agriculture Organization of the United Nations, Rome, FAO Fisheries Circular No 307, Jan 1969. 20 p, 191 ref.

Descriptors: *Bibliographies, *Freshwater fish, *Mortality, *Fish, *Juvenile fishes, Environmental effects, Fishkill, Water pollution effects, Fish populations, Lampreys, Salmonids, Wind, Piles, Waves (Water), Minnows, Temperature, Catfishes, Killifishes, Diseases, Sunfishes, Dissolved oxygen, Bass, Foods, Perches, Fungi, Darters, Behavior, Hydrogen sulfide, Groundwater, Light, Salinity, Predation, Water levels, Radiation.
Identifiers: Sturgeons, Paddlefish, Osmerid fishes, Goldeyes, Persopsid fishes, Sciaenid fishes, Atherinid fishes, Bottom type, Commensal spawning, Morphology, Population density, Siltation, Cannibalism.

Published data overwhelmingly support the hypothesis that strength of year-class in freshwater fishes is established very early in their life history, often prior to the completion of the larval period. This preliminary bibliography, comprising some 191 entries, documents this hypothesis. It was compiled for circulation among specialists, with objective of soliciting for suggestions, corrections, and additons. Citations are largely from the English-language literature published between 1886 and 1968, of which approximately 51% were published in the decade beginning 1960. The following headings are included in a subject index (with number of citations pertaining to each indicated in parentheses): Behavior (8); bottom type (6); commensal spawning (6); disease (3); dissolved oxygen (15); food (16); fungus (3); groundwater (2); hydrogen sulfide (2); light (10); morphology (5); pollution (15); population density (2); predation and cannibalism (21); radiation (2); salinity (1); siltation (4); water level (18); water temperature (48); wind and wave action (6). A species index is also provided. (Eichhorn-Wisconsin)
W70-02966

**CALORIC AND CARBON EQUIVALENTS OF ZOOPLANKTON BIOMASS,**
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 02L.
W70-02967

**THE ORIGIN AND QUANTITIES OF PLANT NUTRIENTS IN LAKE MENDOTA,**
Wisconsin Univ., Madison.
Gerard A. Rohlich, and William L. Lea.
Lake Investigations Committee Report, Wisconsin Univ, Madison, 1949. 8 p, 6 tab.

Descriptors: *Eutrophication, *Agricultural wastes, *Algae, *Lakes, *Tributaries, Sampling, Flow, Analysis, Fertilization, Plant growth substances, Sewage, Sulfate, Manganese, Iron, Carbon dioxide.
Identifiers: *Inland, Horizontal sampling, Vertical sampling, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Weed beds, Phosphorus, Nitrogen balance.

To obtain a comprehensive picture of eutrophication dynamics of Lake Mendota, Wisconsin, three series of stations--inland, horizontal, and vertical--were established on the lake and its tributaries. Analyses of samples collected at inland stations enabled determination of nutrients retained in the lake. Sampling stations of the horizontal series formed transects from upper parts of streams to their mouths and into the lake. These stations provided information on the modification of original nutrient concentration by weed beds and algae. Vertical series stations were located in two 65-foot-deep and one 80-foot-deep holes. Sampling of three water horizons--surface, thermocline at 10 meters, and about 0.5 meters above the bottom--aimed to reveal variation in nutrient concentration and aquatic biomass with depth. Lake's inflow-outflow balance constituted 130 plus or minus 1.2 cubic feet/second. Analyses of chemical factors included pH, alkalinity, dissolved oxygen, biochemical oxygen demand, soluble phosphorus, total phosphorus, free ammonia nitrogen, total organic nitrogen, nitrite, nitrate, sulfates, silicates, manganese, and iron. During the year 17,460 pounds soluble phosphorus entered the lake, the amount corresponding to an application of 1.8 pounds/acre of lake surface. Enrichment in organic nitrogen, largely in nitrate form, amounted to 259,720 pounds, equivalent to fertilization of 26.7 pounds/acre. (Wilde-Wisconsin)
W70-02969

**SEASONAL DISTRIBUTION, CONSTITUTION, AND ABUNDANCE OF ZOOPLANKTON IN LAKE ERIE,**
Memorial Univ. of Newfoundland, St. Johns. Marine Sciences Research Lab.; and Memorial Univ. of Newfoundland, St. Johns. Dept. of Biology.
Charles C. Davis.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2459-2476, 1969. 5 tab, 14 ref.

Descriptors: *Distribution patterns, *Lake Erie, *Zooplankton, Daphnia, Cyclops, Rotifers, Protozoa.
Identifiers: Asplanchna, Bosmina, Ceriodaphnia, Chydorus, Cladocera, Cyclops, Diaptomus, Holopedium, Keratella, Mesocyclops, Polyarthra, Tropocyclops, Lake Erie Basins.

Distribution, constitution, and abundance of zooplankton in Lake Erie are given on the basis of vertical zooplankton hauls from 28 stations. Among Protozoa, Vorticella, Epistylis, and Codonella were dominant in West Basin in October 1967; Codonella being also abundant in Central and East Basins with Epistylis occurring minimally. In January 1968, Vorticella was abundant in West and Central Basins, Codonella occurring in smaller numbers. Among larger zooplankton at least 15 species (9 genera) of rotifers, 9 species (7 genera) of cladocerans and 13 species (7 genera) of copepods were encountered. Distinct differences in zooplankton populations occur in the three basins of the lake. October biomass of cladocerans and copepods was greatly reduced as compared with July. Among cladocerans Bosmina coregoni occurred mainly in East and Central Basins; B longirostris was more abundant in Western Basin. Copeopd populations of Western Basin were greatly impoverished as compared with other basins. Ratios of seston, chlorophyll a and phytoplankton among three basins exhibited a progressive decrease from west to east. A possible instance of winterkill of microcrustacea was noted in January 1968. (Voigtlander-Wisconsin)
W70-02971

**PRELIMINARY INVESTIGATION OF THE EXPLOITATION OF SOME POTENTIAL NUTRITIONAL RESOURCES BY THREE SYMPATRIC TUBIFICID OLIGOCHAETES,**
Toronto Univ. (Ontario). Dept. of Zoology.
Ralph O. Brinkhurst, and Kian E. Chua.
Journal Fisheries Research Board of Canada, Vol 26, No 10, p 2659-2668, 1969. 2 fig, 3 tab, 24 ref.

Descriptors: *Lake Ontario, *Oligochaetes, *Tubificids, Amino acids, Bacteria, Detritus, Water pollution.
Identifiers: *Nutritional resources, *Toronto Harbor (Canada), *Tubifex, Glycine, Nutrient uptake, Limnodrilus, Peloscolex, Saginaw Bay (Michigan), Lake Huron.

Three species of tubificids (Tubifex tubifex, Limnodrilus hoffmeisteri, Peloscolex multisetosus) characteristic of areas polluted by high amounts of organic matter were studied to determine their utilization of heterotrophic bacteria and glycine. Eight species of bacteria were cultured from mud samples taken from Toronto Harbor. Seven bacteria developed at any one time, with Chromobacterium and Aeromonas alternating in the samples. Peloscolex gut contents yielded all seven species of bacteria; Limnodrilus and Tubifex did not contain Aeromonas; Pseudomonas was absent from Tubifex. Laboratory cultures of worms indicated only one bacterial species survived passage through guts, a different bacterium for each tubificid. Studies on uptake of C-14 tabelled glycine indicated insignificant uptake by Tubifex and Limnodrilus. Significant uptake was demonstrated in Peloscolex, glycine being concentrated in the chloragogen surrounding the intestine. Results may indicate differences in utilization of potential nutritional resources by the three species. Free organic matter and microflora available as food for detritus feeders may be more relevant to their ecology than more commonly investigated physical and inorganic factors. Tabular data include results of bacterial identifications from filed and laboratory studies. (Voigtlander-Wisconsin)
W70-02972

**IN VITRO RESPONSES OF SOFT WATER ALGAE TO FERTILIZATION,**
Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Division of Research Paper No 2024, Aug 1969. 16 p, 2 fig, 4 tab, 9 ref.

Descriptors: *Bioassay, Phytoplankton, Lakes, Eutrophication, Sampling, Surfaces waters, Carbon, Fertility, Algae, Nitrogen, Phosphorus, Water pollution effects.
Identifiers: *Twelve Mile Lake (Canada), *Ontario, *Canada, Nutrient levels, Soft water.

A 'preliminary' single sample from oligotrophic Twelve Mile Lake, Ontario, was bioassayed by spiking with sodium bicarbonate, potassium nitrate, and potassium dihydrogen phosphate, or combinations of these compounds. Bottles were carried 21 days at 20 C under a diurnal cycle of 14 hours light and 10 hours dark under the extremely high light intensity of 4000-foot-candles. The sample's indiginous population served as the assay response organisms, and were measured by Areal Standard Units. The only response by the algae in the sample was to a combination of nitrogen and phosphorus. (Gerhold-Wisconsin)
W70-02973

**COMPOSITION AND HORIZONTAL DISTRIBUTION OF CRUSTACEAN PLANKTON IN LAKE ONTARIO,**
Fisheries Research Board of Canada, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 02H.
W70-02975

**DO MARINE CRUSTACEANS RELEASE DISSOLVED AMINO ACIDS,**
Virginia Inst. of Marine Science, Gloucester Point; and Georgia Univ., Athens. Dept. of Zoology.
Kenneth L. Webb, and R. E. Johannes.
Comparative Biochemistry and Physiology, Vol 29, p 875-878, 1969. 11 ref.

Descriptors: *Crustaceans, *Marine animals, *Amino acids, Bacteria, Ammonia, Nitrogen, Phosphorus, Invertebrates, Incubation, Amphipoda, Copepods, Metabolism, Density.
Identifiers: *Amino acid release, Calanus helgolandicus, Calanus chilensis, Palaemonetes pugio, Bacterial action.

Marine bacteria multiply rapidly within a few hours when sea water is enclosed in containers, increasing in numbers by several orders of magnitude. Many species of heterotrophic marine bacteria whose nutrient requirements have been published have been shown to require one or more amino acids for maximum growth. Surfaces of zooplankters and their fecal pellets provide abundant seed of bacteria in incubation vessels. For this reason, incubation times should be held to a minimum to avoid servious loss of amino acids from solution. The new experiments described indicate the general effect bacteria have on dissolved amino acid levels during prolonged incubations. Previous workers give tables in which all eight species of aquatic crustaceans cited were found to release dis-

solved amino acids. Serious errors arise in the measurement of release of dissolved amino acids by marine animals if incubation times exceed a few hours. Longer incubation periods allow bacteria to reach high densities and to remove significant quantities of amino acids from solution. This probably explains the conflict between researchers who find that marine crustaceans release dissolved amino acids and those who fail to detect this release. (Jones-Wisconsin)
W70-02976

**ARE DISSOLVED AMINO ACIDS AN ENERGY SOURCE FOR MARINE INVERTEBRATES,**
Georgia Univ., Athens. Dept of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
R. E. Johannes, S. J. Coward, and K. L. Webb.
Comparative Biochemistry and Physiology, Vol 29, p 283-288, 1969. 1 tab, 30 ref.

Descriptors: *Marine animals, *Invertebrates, *Amino acids, *Energy, Radioactivity techniques, Organic compounds, Carbon radioisotopes, Georgia, Salinity, Sea water, Biological membranes.
Identifiers: Amino acid uptake, Release, Bdelloura candida, Specific activity, Sapelo Island (Georgia), Microbial contaminants, Marine invertebrates, Amino acid loss, Putter's theory.

Marine invertebrates possess high concentrations of free amino acids (FAA) in their tissues several orders of magnitude higher than FAA levels in sea water. Labeled FAA entering these animals are presumably diluted with large endogenous unlabeled FAA pools with resulting pronounced decrease in specific activity. Subsequent release of labeled FAA from the animals into the medium in quantities that are small relative to the amounts of uptake cannot be assumed to indicate that the amount of unlabeled FAA released is also small. A unit of carbon-14-labeled FAA moving out of the animals will represent the flux of a greater quantity of unlabeled FAA than a unit of carbon-14 moving into them. Removal of radioactively labeled organic compounds from solution by marine invertebrates does not constitute proof of net uptake of these compounds. Observations on uptake of carbon-14-labeled dissolved FAA and the release of total dissolved FAA by Bdelloura candida, indicate the net flux of these compounds is outside the animal. Evidence is discussed indicating that there is a net loss of dissolved FAA by various other marine invertebrates. (Jones-Wisconsin)
W70-02977

**MOULTING OF EUPHAUSIA PACIFICA AS A POSSIBLE MECHANISM FOR VERTICAL TRANSPORT OF ZINC-65 IN THE SEA,**
Oregon State Univ., Corvallis. Dept. of Oceanography.
Scott W. Fowler, and Lawrence F. Small.
International Journal of Oceanology and Limnology, Vol 1, No 4, p 237-245, 1967. 3 tab, 10 ref.

Descriptors: *Zinc radioisotopes, *Oceans, Pacific Ocean, Plankton, Migration patterns, Temperature, Salinity, Nuclear explosions, Nuclear reactors, Retention, Oregon, Columbia River, Radioactivity, Sampling, Adsorption, Depth, Surface waters, Columns, Phytoplankton, Food webs, Pollution, Euphausiids.
Identifiers: *Euphausia pacifica, *Vertical transport, *Moulting, Exoskeletons, North Pacific Ocean, Pycnocline, Uptake, Richland (Washington), Specific activity, Halocline, Exuvia, Hanford Nuclear Reactors.

In large concentrations of zinc-65, exoskeletons of Euphausia pacifica accumulate substantial loads of the isotope. As E pacifica is an abundant vertical migrant in North Pacific, moulting approximately every five days, heavy zinc-65 accumulation in exoskeletons could be a major mechanism of vertical transport of the isotope. Moulted exoskeletons averaged 41% of total body activity prior to moulting in uptake experiments, and in loss experiments 18%. Percentage loss from animals alternately accumulating and losing activity was about 30%. Zinc-65 activity in case exoskeletons correlated roughly with whole body activity before moulting, but apparently was not correlated with water temperature, animal size, or initial zinc-65 concentration. Lack of correlation with these factors probably was due partially to exoskeleton size differences and exuvia removal from experimental flasks at only 24-hour intervals. Zinc-65 loss rates from animals via moulting were computed for three hydrographic conditions common in North Pacific. Assuming same concentrations of zinc-65 under these conditions, highest loss rate was in a well-mixed water column (zinc-65 homogeneously distributed), lowest rate when zinc-65 was distributed above a pychocline in summer. Sinking of radioactive exuvia and ingestion of exuvia by other organisms is discussed. (Jones-Wisconsin)
W70-02978

**GROWTH RATE AND BODY COMPOSITION OF FINGERLING SOCKEYE SALMON, ONCORHYNCHUS NERKA, IN RELATION TO TEMPERATURE AND RATION SIZE,**
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
J. R. Brett, J. E. Shelbourn, and C. T. Shoop.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2363-2394, 1969. 17 fig, 8 tab, 49 ref, appendix A, B.

Descriptors: *Growth rates, *Sockeye salmon, Efficiencies, Feeding rates, Food abundance, Maintenance, Temperature, Sampling, Fish.
Identifiers: Body composition, Calorific values, Gross efficiency, Net efficiency, Oncorhynchus nerka, Bioenergetics, Experimental tanks.

Growth of fingerling sockeye salmon was studied under controlled laboratory conditions at temperatures of 1, 5, 10, 15, 20 and 24 C in relation to artificial rations of 0, 1.5, 3, 4.5 and 6% of dry body weight/day and at excess rations. Optimum growth occurred at about 15 C for two highest rations and shifted progressively to lower temperatures at each lower ration. Maximum growth rates varied from 2.6% per day (5-7 month-old fish) to 1.6% per day (7-12 month-old fish). Maintenance requirement varied from approximately 0.4% weight/day at 1 C to 4% at 23 C, rising rapidly above 12 C. Curves relating ration and growth rate were logistic for 20 C and geometric at lower temperatures. No growth was noted at 23 C under excess rations. Calculated isopleths indicated maximum gross efficiency of 25% at 11.5 C and 4% weight/day ration and maximum net efficiency of 40% in the range 8-10 C and 0.8 (maintenance level) to 1.5% weight/day ration. Proximate analyses revealed ranges of water, protein, and fat from 86.9, 9.4, and 1.0% respectively at 20 C after 83 days starvation to 71.3, 19.7 and 7.6% at 15 C and excess rations. (Voigtlander-Wisconsin)
W70-02979

**ACUTE TOXICITY OF ZINC TO THE KILLIFISH, FUNDULUS HETEROCLITUS,**
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Fish-Pesticide Research Lab.
Ronald Eisler.
Chesapeake Science, Vol 8, No 4, p 262-264, 1967. 2 fig, 9 ref.

Descriptors: *Toxicity, *Killifishes, Salinity, Hydrogen ion concentration, Temperature, Spectroscopy, Marine fish, Freshwater fish, Estuarine environment.
Identifiers: *Zinc, *Fundulus heteroclitus, Gill arch, Liver.

During preliminary experiments on effects of sublethal concentratns of insecticides to marine organisms, it was observed that zinc and other metals accumulate in selected tissues of several species. Quantitative date on zinc toxicity to marine fishes were lacking. Effects of different levels of sinc in seawater on the mummichog were explored. Groups of adult Fundulus heteroclitus were subjected to varying concentrations of zinc as zinc chloride at 24 parts/thousand salinity, pH 8.0 and 20 C. At 192 hours, all mummichogs exposed to 43 parts/million or less of zinc were alive and externally indistinguishable from the controls. There were no appreciable differences of zinc content in various tissues, (determined by atomic absorption spectroscopy) regardless of the initial amount of zinc in solution. All mummichogs subjected to 157 parts/million or 180 parts/million of zinc died between 24 and 48 hours. Dead mummichogs were separated into liver, gill arch, and remainder (primarily carcass); they contained about 7 and 8 times more zinc in whole fish and in gill arch, respectively, than controls, thus providing an index of sinc-caused mortality for the species. (Jones-Wisconsin)
W70-02980

**THE ECOLOGY OF A DIATOM COMMUNITY IN A THERMAL STREAM,**
Washington Univ., Seattle. Dept. of Zoology; and Freshwater Biological Association, Ambleside (England).
John G. Stockner.
British Phycological Bulletin, Vol 3, No 3, p 501-514, 1968. 5 fig, 4 tab, 26 ref.

Descriptors: *Physiological ecology, *Diatoms, *Thermal water, *Streams, Nutrients, Bioindicators, Phosphates, Nitrates, Bicarbonates, Hot springs, Hydrogen ion concentration, Thermal pollution, Alkalinity, Carbonates, Conductivity, Iron, Sodium, Sedimentation, Cores, Potassium, Epiphytes, Magnesium, Paleoecology, Sulfates, Washington, Chlorides, Water chemistry, Water pollution.
Identifiers: *Thermobiology, Epipetic flora, Total dissolved solids, Rhopalodia, Denticula, Mastogloia, Amphora, Navicula, Nitzschia, Caloneis, Diploneis, Surirella, Photobiology, Seasonal effects, Anomoeoneis, Epithemia, Gomphonema, Pinnularia, Achnanthes, Phosphorus (Total), Mount Rainier National Park, Ohanapecosh Hot Springs (Wash), Oedogonium.

The structure of diatom communities has been used as a bioindicator of manmade river pollution. Suitable parameters of community structure include a species diversity index derived from the Shannon-Wiener information function (H, the negative summed product, for species 1 to s, of proportion of each species by its natural logarithm) and the redundancy, a measure of degree of repetitious counting ($R = 1 - H/\ln s$). Community structures of diatoms in stream draining one of the Ohanapecosh Hot Springs, Washington, were examined during 1964-1967. Despite large seasonal changes in abundance and shifts in species composition, values for H generally did not deviate significantly from the mean, such relative constancy being interpretable as an indication of community stability. The conclusion is that stream strikingly resembles culturally polluted waters and characteristic pattern of species abundance is attributed to their light adaptation. Three cores, obtained from the soft sediments of the spring, were analyzed for diatom remains. Cores were dated on the basis of a pumice layer of known age, and interpretations bearing on paleoecology of the diatom community added a significant temporal dimension to annual analyses. (Eichhorn-Wisconsin)
W70-02981

**OXIDATION REACTIONS OF NITROGEN IN WATER RECEIVING SECONDARY TREATMENT PLANT EFFLUENTS,**
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
Charles D. Gates.
Available from the Clearinghouse as PB-189 044, $3.00 in paper copy, $0.65 in microfiche. Cornell University Water Resources and Marine Sciences Center Technical Report No 15, June 1969. 15 p, 3 fig, 3 tab, 39 ref. OWRR Project A-012-NY.

Descriptors: *Biochemical oxygen demand, *Oxidation, *Nitrification, *Biodegradation, *Nutrients, Waste disposal, Sewage effluents, Laboratory tests, Waste dilution, Water quality.
Identifiers: Biological treatment plant effluents, Effluent oxidation.

Microbiological and engineering studies on the oxidation or inorganic nitrogen in controlled laboratory studies and in natural waters receiving wastewater are reviewed. Laboratory studies were undertaken to learn the nature and stoichiometry of the reactions, particularly the long-term oxidation, of the inorganic nitrogen constituents of a biological secondary wastewater treatment plant effluent in the receiving water. The progressive oxygen demand of an effluent, diluted with water from the stream to which it is discharged, incubated at 20 deg C, was followed for periods of up to 40 days. In all cases the oxygen consumption curves showed a phase interpreted as the oxidation of inorganic nutrients. Inability to establish natural environmental conditions in the laboratory seriously hampers in vitro studies of the nitrification phenomenon. (Knapp-USGS)
W70-03034

**TEMPERATURE AND TURBULENCE EFFECTS ON THE PARAMETER (DELTA) IN THE STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,**
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center; Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering; and Virginia Polytechnic Inst., Blacksburg. Dept. of Statistics.
Joseph R. Bosley, John J. Cibulka, and Richard G. Krutchkoff.
Available from the Clearinghouse as PB-189 086, $3.00 in paper copy, $0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Bulletin 33, Nov 1969. 33 p, 10 fig, 3 tab, 11 ref. OWRR Proj No A-027-VA, FWPCA Grant No WP-01216-01.

Descriptors: *Dissolved oxygen, *Reaeration, *Biochemical oxygen demand, *Turbulence, *Water temperature, Water pollution effects, Streamflow, Oxygen sag, Waste assimilative capacity, Statistical models.
Identifiers: Dissolved oxygen calculations.

A literature review and laboratory study were made of the effects of water temperature and turbulence on dissolved oxygen and BOD in streams. Methods used to calculate the effects of pollution upon the assimilative capacity of a stream are reviewed. The equations available in the literature make possible calculations of BOD and dissolved oxygen concentrations if initial conditions and dynamic parameters are known. A series of simulated DO sag curves under varying conditions of temperature and turbulence were developed in the laboratory. These were accomplished by probe measurements of dissolved oxygen in a series of test solutions to which glucose feed solutions were added. The stream parameters were estimated and the parameter delta, the incremental DO change, was calculated under each test condition. A plot of temperature versus delta and turbulence versus delta demonstrated that the parameter was of a physical nature. This concept of delta allows an investigator to predict a range of dissolved oxygen values given a set of initial conditions. The probability of any actual DO value falling within this range may also be obtained, allowing intelligent pollution control decisions to be made based on the probability function. (Knapp-USGS)
W70-03066

**EFFECTS OF THERMAL STRATIFICATION UPON OXYGEN RESOURCES - JOHN H. KERR RESERVOIR,**
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Robert C. Horn, and Russel H. Wyer.
Federal Water Pollution Control Administration Middle Atlantic Region, Technical Paper TS-1, June 1968. 15 p, 6 fig, 1 tab, 1 map.

Descriptors: *Water quality, *Dissolved oxygen, *Stratification, *Reservoirs, *Virginia, Thermal stratification, Epilimnion, Hypolimnion, Water pollution sources, Water quality act, Water quality control, Water resources development, Reservoir operation.
Identifiers: *Roanoke River (Va), John H. Kerr Reservoir (Va).

During the 1967 stratification period, a study was made of the oxygen resources of the John H. Kerr Reservoir and Roanoke River, Virginia. Vertical sections of dissolved oxygen and temperature were sampled at 14 stations in the reservoir throughout the summer. These parameters were monitored continuously in the tailrace and several times at 9 stations along the course of the river below the dam. Thermal stratification takes place in the reservoir between June and September; stratification was similar for all years. The thermocline is 20-40 ft deep and most clearly defined in July and August. Dissolved oxygen concentrations in the hypolimnion generally range from 0.0 mg/l to 2.5 mg/l throughout the reservoir in July, August, and the first weeks of September. Most of the water passing through the penstocks is drawn from the oxygen-deficient hypolimnion resulting in contravention of State Water Quality Standards immediately below the dam for approximately two months each summer. No significant relationship exists between magnitude of discharge and dissolved oxygen in the tailrace. (Knapp-USGS)
W70-03070

**THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS: 2. A SIMPLIFIED METHOD OF CALCULATION,**
Army Terrestrial Sciences Center, Hanover, N.H.
S. Lawrence Dingman, and Andrew Assur.
Cold Regions Research and Engineering Laboratory Research Report No 206, Part 2, Aug 1969. 10 p, 3 fig, 1 tab, 5 ref, 1 append. DA Task No 1T061102B52A02.

Descriptors: *Thermal pollution, *Ice, *Melting, *Heat balance, Heat transfer, Water temperature, Equations, Heated water, Path of pollutants.
Identifiers: Heat loss equations.

Equations are presented and explained for use in calculating heat loss rates, temperature profiles, and lengths of ice-free reaches caused in rivers by thermal pollution sources. The use of computers is not necessary to solve the equations, which are linear functions of the difference between water temperature and air temperature. Another simple procedure for calculating heat losses is based on air temperature, wind speed, solar radiation, and general atmospheric conditions. (Knapp-USGS)
W70-03089

## 5D. Waste Treatment Processes

**OXIDATION PONDS REMOVE BACTERIA,**
Department of Water Resources, Durham, N.C.
J. R. Malone, and T. L. Bailey.
WATER AND SEWAGE WORKS, Vol 116, No 4, p 136-140, Apr 1969. 2 fig, 3 tab, 9 ref.

Descriptors: *Oxidation lagoons, *Disinfection, *Tertiary treatment, Pilot plants, Coliforms.
Identifiers: *Bacterial removal, *Nutrient stripping enterococci, Durham, N.C.

This article reports the results of a pilot plant study. Tertiary oxidation ponds can be used to substitute for chlorination of plant effluents at a financial saving. Furthermore, benefits in reduction of BOD and turbidity and plant breakdown buffering capacity add to the reasons for preferring the ponds over chlorination. Short-lived radioisotopes in hospital and lab wastes are given time to decay before reaching the receiving stream. Algae removal from the pond effluent needs further study. (Ledbetter-Texas)
W70-03040

**AERATED STABILIZATION BASIN TREATMENT OF WHITE WATER,**
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk.
Water Wastes Engr, Vol 6, No 7, p D.1-D.5, July 1969. 5 fig, 4 tab.

Descriptors: *Biological treatment, *Design data, *Industrial waste, Costs, Cost analysis, Biochemical oxygen demand.
Identifiers: *Aerated lagoon, *Stabilization pond, Pilot plant studies, Boxboard wastes, Clarification, Suspended solids, Nutrient addition.

A study of a boxboard manufacturing waste and its biological treatment is described. The performance of an existing clarifier which removed 65 to 95% of the suspended solids (600 to 1800 mg/l) and reduced the BOD by 35 to 40% was studied. A pilot scale aerated stabilization basin was used to study the efficacy of this type of treatment. The addition of nitrogen and phosphorus permit a 75% BOD removal with a short-term basin and a clarifier or a long-term basin without a clarifier. The minimum cost alternative was estimated at about 4.5 cents per pound of BOD removed. (Ledbetter-Texas)
W70-03041

**COMBINED TREATMENT OF TANNERY AND MUNICIPAL WASTES,**
Syracuse Univ., N.Y. Dept. of Civil Engineering; and Vrooman (Morrell), Gloversville, N.Y.
Nelson L. Nemerow, and Richard Armstrong.
Water Wastes Engr, Vol 6, No 7, p D.6-D.9, July 1969. 5 fig, 3 tab.

Descriptors: *Industrial wastes, *Municipal wastes, Design data, New York, Biochemical oxygen demand, Sludge digestion, Activated sludge.
Identifiers: *Combined wastes, *Tannery wastes, Laboratory models, Stream survey, Conventional treatment.

This report is the result of a consulting study that was made on the wastes and waste treatment at Gloversville and Johnstown, New York. A stream survey was made to determine the BOD removals required to keep the steam DO about 2 mg/1. This survey indicated that 65 to 97% removal would be necessary. Laboratory studies were run to find whether the mixture of the tannery waste and the municipal waste was amenable to treatment by conventional activated sludge process. The recommended treatment scheme varied from the conventional in that a two-stage secondary treatment (high rate roughing filters followed by activated sludge treatment with mechanical aeration) was included. (Ledbetter-Texas)
W70-03042

**POLLUTION ABATEMENT OF A DISTILLERY WASTE,**
Kentucky Univ., Lexington; Watkins (G. Reynolds), Lexington, Ky.; and Aer-O-Flo Corp., Florence, Ky.
C. E. Burkhead, C. A. Lessig, and T. R. Richardson.
Water Wastes Engr, Vol 6, No 5, p C.20-C.22, May 1969. 2 fig, 4 tab, 12 ref.

Descriptors: *Industrial wastes, *Activated sludge, *Design data, Costs, Construction costs, Heat transfer, Biochemical oxygen demand, Biological treatment.
Identifiers: *Pilot studies, *Distillery wastes, *Oxygen transfer, Suspended solids, Settleable solids, Brewery wastes.

Operating data for a pilot plant waste treating operation is described. A 5000-gal holding tank (for cooling wastes) and a 10,000-gal extended

aeration activated sludge tank (including a 1670-gal settling unit) were used to treat loadings of 4250 to 10,500 gal per day of wastes. BOD removals ranged from 77 to 97% (avg of 91.5%) at loadings of 3 to 27 lb/day-1000 cuft (avg of 18 lb). The volume of the holding tank is included in the loading calculations. The effluent quality must be of the order of 20 to 30 mg/l BOD. Aerated lagoons give an economical adaptation of the activated sludge process. In addition to BOD removal, the large surface area enhances heat removal from the hot wastes. The aerated lagoon design was for a pond 3 feet deep with 5 days retention. The pond may be operated at a depth of 5 feet if necessary to get the desired effluent quality. The cost of the pond construction is estimated at $71,000. (Ledbetter-Texas)
W70-03043

**ENGINE PLANTS RECOVER AND REUSE OIL FROM WASTEWATER,**
Ford Motor Co., Cleveland, Ohio. Cleveland Engine Plants.
S. J. Halasz, C. C. Keil, and G. J. Schutt.
Water Wastes Engr, Vol 6, No 5, p C.24-C.28, May 1969. 2 fig.

Descriptors: *Skimming.
Identifiers: *De-emulsification, *Oil removal, Settling lagoon, Cutting oils, Soluble oils, Reclaimed oil, Water recycle.

A treatment system that reclaims oil from wastewater at the engine plant of Ford Motor Co. in Cleveland is described. Lubricating oil, honing oil, and hydraulic oil are insoluble and will float to the surface for skimming along with varying amounts of the soluble cutting oils. Most of the soluble oil is in an inverted emulsion which is broken by heating with de-mulsifying agents. The mixture is put into a settling lagoon where it separates into three fractions--oil, oil-water mixture, and water. The oils are removed, treated, and reclaimed. The water is returned to the surge tank for reuse. This treatment scheme has resulted in a better oil and a savings in cost. (Ledbetter-Texas)
W70-03044

**REMOVAL OF ORGANIC COLLOIDS BY MICROFLOTATION,**
Clarkson Coll. of Technology, Potsdam, N.Y.; and Ohio State Univ., Columbus. Water Resources Center.
E. A. Cassell, A. J. Rubin, H. B. LaFever, and E. Matijevic.
Water Wastes Engr, Vol 6, No 5, p C.7-C.10, May 1969. 9 fig, 2 tab, 19 ref.

Descriptors: *Foam separation, *Model studies, E. Coli, Electrolytes, Tertiary treatment.
Identifiers: *Microflotation, Color removal, Turbidity removal, Bacteria removal.

The application of microflotation or foam separation to the treatment of wastewaters seems practical in many water renovation applications at the present. Microflotation can replace coagulation-sedimentation and be followed by the new high-rate filters. This unit would be compact because of the rapid removal of the color-and turbidity-causing particles. It is also a rapid and efficient method of removing bacteria. Research is needed to better understand the effects of various types of dispersions, electrolytes and/or polyelectrolytes. Test data for the removal of the colloidal materials by foam separation is presented. (Ledbetter-Texas)
W70-03045

**MODERN AERATION TECHNIQUES,**
Fuller Co., Catasauqua, Pa. Infilco Products Group.
Charles E. Tharp.
Water Wastes Engr, Vol 6, No 6, p 31-33, June 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Aeration, *Biological treatment, *Activated sludge, Design data, Biochemical, Oxygen demand.
Identifiers: *Aeration equipment, *Oxygenation, *Porous diffusers, Turbine aerators, Brush aerators, Pump-type horsepower, Power consumption.

A description of the basic mechanisms for oxygenation of wastewaters is described. The power requirements for a radial flow surface aerator, a submerged turbine aerator, and porous diffusers are 20, 40, and 50 HP, respectively, for 1 mgd flow with a BOD-5 of 250 mg/l. The article gives design data and practices for aeration during biological wastewater treatment. (Ledbetter-Texas)
W70-03046

**NEW APPROACH TO AEROBIC TREATMENT OF WASTES,**
Allis-Chalmers Mfg. Co., Milwaukee, Wis. Water Pollution Research.
Fred M. Welch.
Water Wastes Engr, Vol 6, No 7, p D.12-D.15, July 1969. 5 fig, 2 ref.

Descriptors: *Aerobic treatment, *Biological treatment, Dissolved oxygen, Temperature.
Identifiers: *Aerobic digestion, Process development, Hydraulic loading, Chemical oxygen demand, Suspended solids, Revolution rate, Rotating biological contractor.

Tests run on a Rotating Biological Contractor (RBC) using a synthetic sewage developed at the Univ of Wisconsin are described. The concentration of influent was varied from 500 to 4000 mg/l COD and the hydraulic flow rate from 200 to 800 gph. The RBC is a series of rotating disks that are partially submerged and are rotated in the waste. It was concluded that the many process variables make the RBC suitable for treating a wide range of biodegradable wastes. The RBC retains a large fixed biological film, but, unlike the trickling filter, it effectively utilizes the entire film surface area and is not susceptible to clogging. Pilot plant work is being conducted in connection with an industrial application. (Ledbetter-Texas)
W70-03047

**STORMWATER DISINFECTION AT NEW ORLEANS,**
Pavia-Byrne Engineering Corp., New Orleans, La.; and New Orleans Sewage and Water Board, La.
Edgar H. Pavia, and Crawford J. Powell.
J Water Pollut Contr Federation, Vol 41, No 4, p 591-606, Apr 1969. 10 fig, 1 ref.

Descriptors: *Chlorination, *Storm runoff, *Disinfection, Chlorine, Design, Pumping plants, Coliforms.
Identifiers: *Hypochlorites, *New Orleans, *Lake Ponchartrain, Open channels.

A progress report is given on a project to disinfect storm waters in New Orleans. The project aims to show the feasibility of reducing the coliform count by adding chlorine or hypochlorite at pumping stations and letting disinfection take place in open channels of populated areas. The study will encompass the effect of such treated storm waters when they are discharged into body contact recreational areas. The Lake Ponchartrain area of New Orleans is the site of the test to begin in early 1969. (Ledbetter-Texas)
W70-03048

**LABORATORY STUDIES OF TANNERY WASTE TREATMENT,**
Washington Univ., St. Louis, Mo.; Vanderbilt Univ., Nashville, Tenn.; and Tennessee State Div. of Streams Pollution Control, Nashville.
H. D. Tomlinson, E. L. Thackston, P. A. Krenkel, and V. W. McCoy.
J Water Pollut Contr Federation, Vol 41, No 4, p 660-678, Apr 1969. 13 fig, 10 tab, 30 ref.

Descriptors: *Industrial wastes, *Activated sludge, *Chemical precipitation, Neutralization, Lime, Pilot plants.
Identifiers: *Tannery wastes, *Chrome tanning, *Alum tanning, *Vegetable tanning, Leather.

The laboratory development of treatment processes for chrome, alum, and vegetable tanning wastes is described. They give the chemical and other characteristics for the various waste streams at the tannery, then present their recommendations for treatment. The recommended practice is separate pretreatment of the spent vegetable tanning liquor (p H adjust and alum coagulation), chrome tanning liquor (pp t with lime), and dye wastes (color removal) followed by a combined biological treatment (completely mixed activated sludge). (Ledbetter-Texas)
W70-03049

**CENTRIFUGES CONCENTRATE AND DEWATER WASTE SYSTEM SOLIDS,**
Pennsalt Chemicals Corp., Warminster, Pa. Sharples-Equipment Div.
Frederick W. Keith, Jr.
Water and Sewage Works (Industrial Wastes Supplement) Vol 116, No 3, p IW/10-IW/18, Mar 1969. 11 fig, 1 tab.

Descriptors: *Centrifugation, *Dewatering, *Sludge treatment, Coagulation, Sedimentation, Pulp and paper industry, Municipal wastes, Industrial wastes efficiencies.
Identifiers: *Scroll centrifuge, *Disc centrifuge, Petroleum refinery, Electrochemical machining.

Centrifuges are used on relatively small volume waste streams, usually after gravity concentration. Scroll centrifuges and disc centrifuges are described with applications in paper and pulp industry, petroleum refinery, municipal waste treatment, and electrochemical machining. Efficiency curves are shown for these applications. The authors conclude that the use of centrifuges in wastewater treatment will continue to increase. (Ledbetter-Texas)
W70-03050

**WASTEWATER TREATMENT PLANT OPERATIONAL PROBLEMS AT HAIFA, ISRAEL,**
Haifa Municipality Sewage Treatment Plant (Israel).
Michael Lubzens.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 413-417, Mar 1969. 2 fig, 1 ref.

Descriptors: *Scum, *Operation and maintenance, *Water reuse, *Detergents, *Ammonia, Irrigation, Salinity, Cotton, Cooling towers, Digestion tanks, Mixing.
Identifiers: *Biofiltration, *Reuse, *Suspended solids.

The Haifa, Israel, wastewater treatment plant treats 8.8 mgd of waste from 270,000 people. The plant is overloaded by 15 to 20 percent and is being doubled in size. The present treatment entails primary sedimentation, two-stage biofiltration, secondary sedimentation and chlorination. The effluent BOD is 35 (summer) to 75 (winter) mg/l after removals of 95% and 86%, respectively. The effluent contains (1) psychoda fly larvae, pupal, and discarded pupal skins because no secondary skimming is practical. (2) 1200 to 1400 mg/l of dissolved solids; (3) 60 mg/l of ammonia; and (4) 15 mg/l of detergents (as ABS). The salinity limits reuse of the effluent to cotton irrigation and the ammonia and detergents prevent its use in cooling towers. Scum on the digesters (up to 10 ft) is causing problems. The new design plans to use the existing plant more effectively and to lower effluent BOD, turbidity and suspended solids. (Ledbetter-Texas)
W70-03051

**CANNERY WASTE TREATMENT BY SPRAY IRRIGATION-RUNOFF,**
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.; and Campbell Soup Co., Napoleon, Ohio.
T. W. Bendixen, R. D. Hill, F. T. DuByne, and G. G. Robeck.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 385-391, Mar 1969. 2 fig, 9 tab, 4 ref.

Descriptors: *Canneries, *Industrial wastes, *Foods, *Tomatoes, Irrigation, Runoff, Soil treatment, Grasslands, Wastewater treatment, Ohio, Chemical oxygen demand.
Identifiers: *Cannery waste, *Spray irrigation, Food processing.

A spray irrigation-runoff system is used to treat the wastes from a tomato-processing plant. The facility employs 5 plots containing a total of 165 acres. The waste is sprayed intermittently, 6 hrs on and 6 hrs off, at the top of 5% grassy slopes and the runoff collected after runs of 100 to 200 ft. Tests show that 30 to 40% of waste runs off, with the treatment efficiencies as follows: COD, 95%; nitrogen, 93%; phosphates, 84% and suspended solids, 97%. Rainfall increases the runoff and decreases the efficiencies. (Ledbetter-Texas)
W70-03052

**TREATMENT OF MIXED INDUSTRIAL WASTES AT BAYPORT'S INDUSTRIAL COMPLEX,**
Friendswood Development Co., Houston, Tex.
George B. Meriwether.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 440-444, Mar 1969. 1 fig, 2 ref.

Descriptors: *Industrial wastes, *Activated sludge, Biological treatment, Incineration, Cost allocation, Costs, Classification, Waste water treatment.
Identifiers: *Central treatment facility, *Mixed wastes, Houston (Tex), Segregation of wastes.

A central waste treatment facility is described; it is serving 6 industries presently with 6 more industries under construction. The capacity is about 1 MGD now and can be expanded to 40 MGD. The wastes are sorted into 3 classes: a 'clean' stream, a 'biological' stream, and a non-acceptable stream. The first two categories can be treated biologically while the third requires incineration or deep-well injection. The plant charges $0.34 to $0.44 per 1000 gal with BOD up to 250 mg/l and $0.17 to $0.22 per lb of BOD for wastes with BOD greater than 250 mg/l. (Ledbetter-Texas)
W70-03053

**ACTIVATED SLUDGE STUDIES AT DECATUR, ILLINOIS,**
Decatur Sanitary District, Ill.
Charles E. Hughes, Jr., and Jeramiah F. Reynolds.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 184-198, Feb 1969. 22 fig, 1 tab.

Descriptors: *Activated sludge, *Aeration, *Dissolved oxygen, Efficiencies, Toxicity, Analytical techniques, Domestic wastes.
Identifiers: *Cross roll aeration, *Operating problems, Diffusers, Sparjers, Alpha coefficient, Beta coefficient, Decatur (Ill).

This article describes a study of the operating problems in an activated sludge plant. Toxicity studies showed that toxic materials were not the cause of the problems. Low dissolved oxygen was found to be at the root of the difficulties. The aeration was changed from spiral roll to cross roll and oxygen transfer increased 55 to 60%. The authors recommend standard methods of determination for alpha coefficient, K-sub-L A, and beta coefficient, the ratio of oxygen solubility in the waste to that in water. (Ledbetter-Texas)
W70-03054

**OCCURRENCE OF ENTERIC VIRUSES IN WASTEWATER AFTER ACTIVATED SLUDGE TREATMENT,**
Municipal Virological Lab., Goteborg (Sweden); and Goteborg Univ. (Sweden). Institutes of Mecical Microbiology.
Ebba Lund, C. E. Hedstrom, and N. Jantzen.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 169-174, Feb 1969. 2 fig, 10 ref.

Descriptors: *Viruses, *Effluents, *Chlorination, *Activated sludge, Isolation, Temperature, Sampling.
Identifiers: *Enteric viruses, *Viral concentrations, Etherization, Sweden.

The authors report the results of a virus survey on weekly samples for 18 months of an activated sludge effluent from a plant serving 40,000 population (Nasetverket). One sample produced no more than 3 types of viruses. The treatment process reduced the viral count by about 1.5 log units (31x) but was much less effective toward the end of the calendar year. They found no effect from in-plant chlorination. (Ledbetter-Texas)
W70-03055

**TERTIARY TREATMENT AT METRO CHICAGO BY MEANS OF RAPID SAND FILTRATION AND MICROSTRAINERS,**
Metropolitan Sanitary District of Greater Chicago, Ill.
Bart T. Lynam, Gregory Ettelt, and Timothy McAloon.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 247-279, Feb 1969. 36 fig, 9 tab, 7 ref.

Descriptors: *Tertiary treatment, *Cost comparisons, *Activated sludge, Sands, Coagulation, Design criteria, Sedimentation, Computer programs.
Identifiers: *Sand filters, *Microstrainers, Rapid sand filters, Chicago.

Results are reported on 5 months of investigation into tertiary treatment of Hanford Park (Chicago) effluent. A 2 mgd plant with rapid sand filters (traveling backwash) and microstrainer was operated under varying conditions. The sand filter was found to be more economical than the microstrainer for effect achieved, $0.024/1000 gal vs $0.028/1000 gal. Either method with pre-chlorination can meet 5 mg/l suspended solids and 4 mg/l BOD criteria of Illinois Sanitary Water Board. Coagulation with alum did not improve the results achieved. (Ledbetter-Texas)
W70-03056

**USE OF AERATED LAGOONS AND PONDS IN REFINERY AND CHEMICAL WASTE TREATMENT,**
Texas Univ., Austin. Center for Research in Water Resources; and Humble Oil and Refining Co., Baytown, Tex.
Earnest F. Gloyna, S. O. Brady, and H. Lyles.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 429-439, Mar 1969. 5 fig, 7 tab, 6 ref.

Descriptors: *Lagoons, *Aeration, *Industrial wastes, Stabilization, Ponds, Design criteria, Dissolved oxygen.
Identifiers: *Refinery, *Petrochemicals, Stabilization ponds, Aerated lagoons, Houston (Tex).

This paper describes the staged development of industrial wastewater treatment facility for a refinery and petrochemical complex. Emphasis is directed to the utilization of available land for three series-connected waste stabilization ponds, the implementation of this treatment system with an aerated lagoon and the compatibility of this plan with future collection and treatment requirements. The wastewater management plan includes various in-plan separators, and extraction units, an extensive oil collection and separator system, surface aerators, and 351 acres (142ha) of waste stabilization ponds. Provisions can be made to expand the facility if the waste loads continue to increase or additional waste streams are provided by the petrochemical complex. Allowable BOD loading is 50,000 lb/day (22,600 kg). Recommended volume to the first pond is 7.7 mgd (29,200 cu m/day). BOD removal is 72 percent, COD is 84 and 90 percent. (Ledbetter-Texas)
W70-03057

**DIATOMITE FILTRATION IN A BOARD MILL,**
Johns Manville Research and Engineering Center, Manville, N.J.
F. B. Hutto, Jr.
Water Wastes Eng (Industrial), Vol 6, No 3, p B.5-B.9, Mar 1969. 5 fig, 1 tab.

Descriptors: *Filtration, *Diatomaceous earth, Pilot plants, Cost analysis, Design data.
Identifiers: *Board mill, Closed recycle, Makeup water.

A closeup recycle of wastewater is described for a Fesco board (perlite, wood pulp, asphalt, and admix) plant in France. A diatomaceous earth filter (celite 545) with a capacity of 300 gpm was installed after pilot plant tests of various filter aids, including perlite. Rotary knives remove the cake from the drum. About 1 ton per week of the celite 545 must be replaced. River water for make up is brought into the system through the rotary precoat filter. Evaporation occurs at approximately 6000 gph, whereas the volume of the loop is only 12000 gal. The success of the closed cycle lay in: successful removal of solids, stabilization of solubles buildup, and return water reused. (Ledbetter-Texas)
W70-03058

**OPERATING EXPERIENCE WITH HIGH-RATE FILTERS,**
Gary Sheet and Tin Works, Ind.; and United States Steel Corp., Pittsburgh, Pa.
V. F. Frank, and James P. Gravenstreter.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 292-296, Feb 1969.

Descriptors: *Filtration, *Industrial wastes, *Steel, Iron oxides, Wastewater treatment.
Identifiers: *High-rate filters, *Scale, Gary (Ind), Suspended solids, Anthracite, Sand, Gravel.

High-rate gravity filters can remove the iron oxide scale and dust from steel processing water. Twelve filters 15 feet square by 23 feet deep were constructed of 1 foot square concrete blocks covered with 15 in. of gravel, 2 feet of sand, and 5 feet of anthracite. The process produced an effluent with not more than 15 mg/l suspended solids at filtration rates from 16 to 32 gpm/sq ft. The 160,000 gpm ultimate demand can be treated. (Ledbetter-Texas)
W70-03059

**ECONOMIC EVALUATION: ALTERNATIVES FOR INDUSTRIAL TREATMENT,**
Wichita State Univ., Kans.
Kathleen Q. Camin.
Water and Sewage Works (Industrial Wastes Supplement), Vol 116, No 7, p Iw/8-Iw/13, July 1969. 1 fig, 4 tab.

Descriptors: *Cost analysis, *Cost comparisons, Discount rate, Annual costs, Municipal wastes, Industrial wastes, Interest.
Identifiers: *Primary costs, *Secondary costs, Present value, Time horizon, Revenue bonds.

The alternatives for industrial disposition of wastes are the following: (1) complete treatment by municipality, (2) complete treatment by the industry, (3) partial treatment by industry followed by municipal treatment, or (4) alteration of process to produce less waste and/or lower strength. A hypothetical meat packing plant is used as an example to illustrate the costs of the various alternatives in primary costs (repayment of principal, interest, and operation and maintenance) and secondary costs (penalties, sale of products, and public

relations). The annual costs are computed for trickling filter, anaerobic contact, and anaerobic-aerobic lagoons. The present values of the alternatives show the proper selection of treatment for different interest rates. (Ledbetter-Texas)
W70-03060

**SPRAY IRRIGATION OF FERMENTATION WASTES,**
Commercial Solvents Corp., Terre Haute, Ind.
Richard A. Woodley.
Water Wastes Eng (Industrial) Vol 6, No 3, p B.14-B.20, Mar 1969. 2 fig, 2 tab, 16 ref.

Descriptors: *Sprinkler irrigation, *Fermentation, Industrial wastes, Maintenance, Vegetation.
Identifiers: *Fermentation wastes, Terre Haute (Ind).

Spray irrigation is used to treat low-volume, high BOD, industrial fermentation wastes at the Commercial Solvents Corp. plant in Terre Haute, Indiana. Seven other treatment methods for various wastewater streams are employed at the same plant. The monthly average applications over the last 3 years ranged from 43,000 gpd to 85,000 gpd with BOD from 300 mg/l to 65,000 mg/l. The treatment has been applied on 180 of the available 372 acres of land. Monitoring is carried out on the wastes and the groundwater under the area. The vegetation is left on the land during spraying. Some corrosion of the aluminum pipe has been noted. Winter operations have not produced problems. (Ledbetter-Texas)
W70-03061

**ARMCO'S 100,000- gpm MILL-SCALE WASTEWATER TREATMENT PLANT,**
Armco Steel Corp., Middletown, Ohio. Air and Water Pollution Control.
John E. Barker, Richard W. Getter, and Grant A. Pettit.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 301-307, Feb 1969. 7 fig.

Descriptors: *Industrial wastes, *Steel, *Wastewater treatment, Design criteria, Coagulation, Sedimentation, Lime, Vacuum drying, Sludge treatment.
Identifiers: *Mill-scale wastes, *Ferric sulfate, Sludge dewatering polyelectrolytes, Armco, Middletown (Ohio).

The 100,000 gpm (144 MGD) mill-scale, wastewater treatment plant of Armco at Middletown, Ohio, is probably the largest plant of its type in the USA. The plant treats an 86 in. hot strip mill waste in two steps-primary sedimentation and coagulation. The primary treatment unit has 5 sub-systems and the secondary 3. Lime is used to adjust the pH to the range of 8.2 to 8.5 and ferric sulfate used as a coagulant. Four belt type vacuum filters, each with 800 sq ft of filterarea, dewater the sludge which is loaded into gondola cars for disposal. (Ledbetter-Texas)
W70-03062

**CONCENTRATION OF SEAWATER BY ELECTRODIALYSIS,**
Japan Monopoly Corp.
For primary bibliographic entry see Field 03A.
W70-03079

**INTRASOIL UTILIZATION OF SEWAGE WATER SEDIMENTS (RUSSIAN),**
Institute of Medical Parasitology and Tropical Medicine (USSR).
For primary bibliographic entry see Field 03C.
W70-03125

**DESIGN PARAMETERS FOR BOD, SOLIDS AND NUTRIENT REMOVAL BY FOAM FRACTIONATION,**
FMC Corp., Santa Clara, Calif. FMC Machinery/Systems Group.
M. Floyd Hobbs.
FMC Corporation, Central Engineering Laboratories, Technical Report R-2737, Dec 1968. 54 p, 14 fig, 12 tab, 12 ref. FWPCA Grant WRRD-30-01.

Descriptors: *Foam fractionation, *Ion exchange, *Surfactants, *Waste water treatment, *Water pollution control, Vegetable crops, Treatment facilities, Pilot plants, Laboratory tests, Ammonium compounds.
Identifiers: *San Jose, *Santa Clara, *San Francisco Bay, FMC Corporation.

Process development studies and laboratory investigations are described for removing nutrients (especially phosphate) and suspended solids from secondary wastewater treatment effluents by a foam fractionation process using a liquid ion exchange surfactant. Bench studies were conducted on synthetic waste waters and secondary effluent from the San Jose-Santa Clara Water Pollution Control Plant. Findings indicate that removal of orthophosphate, nitrate, nitrite, and sulfate ions is possible using a surface active quaternary ammonium chloride, which can be regenerated to the chloride form. During the vegetable canning season, an objectionably high concentrations of sludge particles and oxygen demanding materials are discharged from the local treatment plant into the San Francisco Bay. The form fractionation process recommended should provide substantial reductions of sludge particles, BOD and nutrients to help meet Bay Area regulations. A pilot plant for processing 10 gpm of effluent from the treatment plant was designed. The portable plant is estimated to cost $50,000. The report includes preliminary findings, additional bench-scale studies needed to quantitate previous results on a continuous-flow basis, and an economic evaluation of design parameters. (Poertner-Chicago)
W70-03137

**RECLAMATION OF WASTEWATER.**
Los Angeles City Dept. of Water and Power, Calif.

Los Angeles, Dept of Water and Power, City of Los Angeles, Oct 1968. 101 p, 30 fig, 11 tab, 55 ref, 8 append.

Descriptors: *Reclaimed water, *Water reuse, *Groundwater recharge, *Groundwater barriers, *Irrigation, Water spreading, Injection, Cooling towers, Water shortage, Recharge.
Identifiers: *Los Angeles, Process water.

This investigation was made to determine what portion, if any, of Los Angeles wastewater can be reclaimed for beneficial uses. The study was divided into three major categories: (1) magnitude of wastewater flows throughout the Los Angeles sewerage system and quality determinations; (2) potential situations for wastewater reuse; and (3) costs. Conclusions were that Los Angeles wastewater can beneficially be used for the following six projects: (1) groundwater recharge by surface spreading of treatment plant effluent at the Headworks, Tujunga and Pacoima spreading grounds; (2) injection of effluent from the Hyperion Treatment Plant into the ground to prevent sea water intrusion (West Coast Basin Barrier Project); (3) supply reclaimed water to Standard Oil's El Segundo Plant for cooling tower and process water; (4) irrigation of golf courses and parks using secondary treatment effluents in the Sepulveda Flood Control Basin; (5) irrigation in Griffith Park; and (6) irrigation of proposed parks in the Santa Monica Mountains with secondary effluent. The report included a recommendation that the City departments of Water and Power and Public works coordinate their efforts to develop and operate these projects. The report concludes that all of Southern California needs new water supplies and recommends wastewater reclamation as economically sound and politically expedient. (Poertner-Chicago)
W70-03141

**A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,**
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03C.
W70-03159

**PRELIMINARY DESIGN OF WASTE TREATMENT SYSTEMS,**
Water Resources Engineers, Inc., Walnut Creek, Calif.
D. E. Evenson, G. T. Orlob, and J. R. Monser.
Ind Water Eng, Vol 16, No 1, p 16-21, Feb 1969. 6 p, 9 fig, 2 tab, 6 ref.

Descriptors: *Dynamic programming, *Waste water treatment, *Biochemical oxygen demand, *Dissolved oxygen, *Ponds, Construction costs, Maintenance costs, Interest rate, Capital, Design, Canneries, Seasonal.
Identifiers: Sensitivity analysis.

Dynamic programming techniques were used to find the best waste treatment system for removing biochemical oxygen demand (BOD) and treating solids at the minimum annual cost. A cannery for processing peaches and tomatoes was chosen for demonstrating the usefulness of dynamic programming in preliminary design. Results indicated that the least costly treatment processes for nearly all levels of BOD removal involved some system of ponds. Senstivity analyses were made to determine the influence of such parameters as interest rate, capital recovery period and land cost on both the cost and choice of the best treatment process. For the cannery waste studied, the minimum cost was found to be most sensitive to the length of the canning season, least sensitive to interest rate. In-plant treatment was opted over municipal treatment when BOD removal requirement was below 85%. (Thiuri-Cornell)
W70-03164

**TIME CAPACITY EXPANSION OF WASTE TREATMENT SYSTEMS,**
Pennsylvania State Univ., University Park; and Stanford Univ., Calif.
Thomas M. Rachford, Russell F. Scarato, and George Tchobanoglous.
J Sanit Eng Div, ASCE, Vol 95, No SA6, p 1063-1077, Dec 1969. 15 p, 4 fig, 4 tab, 15 ref, 1 append.

Descriptors: *Waste treatment, *Economies of scale, *Mathematical models, *Optimization, *Timing, Interest rate, Water demand, Capital cost, Investment, Decision making.
Identifiers: *Time capacity expansion.

A minimum-cost method was developed for quantifying the opposing cost factors of economies-of-scale and the time cost of money as they jointly affect optimal capital investment decisions for the expansion of wastewater treatment systems. For a linear demand growth rate, optimal facility expansion, with regard to both timing and capacity requirements, was determined using a mathematical model. The economic implications of different expansion policies were graphed for various interest rates and scales cost affects, using cost data mathematically formulated as a function of system capacity. The model was used to demonstrate that the optimal timing of facility expansion was a function of the time and cost of money and the economy-of-scale characteristics of that facility and was independent of the absolute capacity of the facility. Further additional economies inherent in individually expanding separable components of wastewater treatment system were quantified by the model. (Thiuri-Cornell)
W70-03167

**PRELIMINARY SELECTION OF WASTE TREATMENT SYSTEMS,**
Water Resources Engineers, Inc., Walnut Creek, Calif.
D. E. Evenson, G. T. Orlob, and J. R. Monser.

J Water Pollut Contr Federation, Vol 41, No 11, Part 1, p 1845-1858, Nov 1969. 14 p, 9 fig, 1 tab, 6 ref.

Descriptors: *Dynamic programming, *Waste water treatment, *Biochemical oxygen demand, *Dissolved oxygen, *Ponds, *Canneries, Construction costs, Seasonal, Maintenance costs, Interest rate, Capital design.
Identifiers: Sensitivity analysis.

Dynamic programming techniques were utilized to find the best waste treatment system for removing a specified amount of biochemical oxygen demand (BOD) at the least annual expenditures for construction maintenance and operation. This technique was applied to wastes typical of a cannery processing tomatoes and peaches. Results of this application indicated that for nearly all removal levels the least expensive treatment process was some system of ponds. Sensitivity analysis were made to determine the influence of such parameters as interest rate, capital recovery period and land cost on both the cost and choice of the best treatment process. For the cannery wastes studied, minimum cost was found to be most sensitive to the length of the canning season and least sensitive to interest rate. In-plant treatment was opted over municipal treatment when BOD removal requirement was below 85%. It was concluded that dynamic techniques outlined could be applied to the preliminary design of waste treatment system. (Thiuri-Cornell)
W70-03169

**USE OF SYSTEMS ANALYSIS METHODS IN DETERMINING NEEDS AND IMPLEMENTING PROGRAMS FOR WASTE TREATMENT FACILITIES.**
Federal Water Pollution control Administration, Washington, D.C.

In Examination into the Effectiveness of the Construction Grant Program for Abating, Controlling, and Preventing Water Pollution, Comptroller General of the United States, Report B 166506, Chap 6, p 80-97, Nov 1969. 18 p, 1 fig, 1 tab.

Descriptors: *Water quality control, *Systems analysis, *Pollution abatement, *Planning, *Waste assimilative capacity, Decision making, Water utilization, Waste treatment.
Identifiers: Merrimack River.

The use of systems analysis methods in determining needs and implementing programs for waste water facilities by the Federal Water Pollution Control Administration was discussed. The application of systems analysis to water quality control by Camp, Dresser and McKee particulary on the Merrimack River was presented. It was concluded that through the systems analysis approach to planning and implementing water pollution programs; (a) a least-cost construction plan to achieve water quality standards can be developed that considered the assimilative capacity of waterways, (b) more costly, but perhaps more desirable, alternative schedules could be developed, and (c) decision-makers will be provided with more meaningful data so as to enable them to determine the level of treatment required to achieve established objective and the costs of providing various levels of water uses. (Thiuri-Cornell)
W70-03176

## 5E. Ultimate Disposal of Wastes

**ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,**
Michigan State Univ., East Lansing. Coll. of Engineering.
For primary bibliographic entry see Field 05B.
W70-02843

**A STUDY OF DRAINAGE CONDITIONS ON A HILLSIDE RECEIVING SEWAGE PLANT WASTE WATER EFFLUENT AT WEEKLY INTERVALS,**
Pennsylvania State Univ., University Park. Dept. of Agronomy.
Joel Claude Myers.
MS Thesis in Agronomy, Pennsylvania State Univ Graduate School, Sept 1967. 102 p, 27 fig, 29 tab, 31 ref, append. OWRR Project No B-001-PA.

Descriptors: *Waste water disposal, *Sewage effluents, *Irrigation, *Hydrogeology, Infiltration, Runoff, Saturated soils, Soil-water-plant relationships, Piezometry, Drainage, Demonstration watersheds, Observation wells, Irrigation water.
Identifiers: Sewage effluent irrigation.

The effects of sewage disposal by irrigation on soil and drainage conditions of a hillside were investigated by applying 2 inches of chlorinated sewage effluent per week for 2 years. The hillside slope consisted of a heterogeneous complex of Hagerstown-Hublersburg series. Ranges of sand, silt, and clay for example, were as follows: Sand (8-47%), silt (12-49%) and clay (21-72%). These and other soil determinations generally indicated great variability in the soil properties, including soil permeability both along the sloping area and within each site. Extent of perched water tables, which are upheld by layers of very low permeability, was determined at the 7 research sites. Generally the water-table surface was within 4 ft of the soil surface, except in dry summer periods where evapotranspiration was at a maximum. In winter, frost, soil and air temperatures, ice and snow caused variable effects on infiltration. Water storage and transmission were greatly reduced because of the perched water tables near the land surface. (Knapp-USGS)
W70-02893

## 5F. Water Treatment and Quality Alteration

**IRON AND MANGANESE REMOVAL,**
Manitoba Water Supply Board.
Jim Adams.
Water and Sewage Works, Vol 116, No 7, p 259, July 1969. 1 p, 1 ref.

Descriptors: *Water treatment, *Iron, *Manganese, Chemical precipitation, Filtration, Filters, Water management (Applied), Oxygenation, Oxidation.
Identifiers: Greensand filters, *Manganese removal.

Methods for removing iron and manganese from water are briefly described. Lime soda treatment is usually effective in removing manganese. On a laboratory scale, the Manitoba Water Supply Board has tried simple aeration to assist in the precipitation of iron and manganese followed by the injection of a 1.0% potassium permanganate solution into the stream. This is then followed by passing the water through a pressure filter containing a manganese greensand bed. The greensand filter will require backwashing possibly every two days, and, in addition, should be backwashed with air one each week. (Knapp-USGS)
W70-02869

**PURE DRINKING WATER: REGULATION OF MINIMUM STANDARDS AND OF METHODS FOR OBTAINING PURE DRINKING WATER.**

Wis Stat Ann secs 162.01-162.06 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water quality control, *Potable water, *Water pollution, Standards, Regulation, Consumptive use, Groundwater, Water sources, Water supply, Public health, Construction, Wells, Well permits, Well regulations, Drilling, Water pumping, Water analysis, Investigations, Sanitary engineering, Water purification, Permits, Administrative agencies, Legal aspects, Legislation, Water pollution control.
Identifiers: Penalties (Civil).

The Department of Resource Development shall prescribe, publish, and enforce minimum standards and rules and regulations for obtaining pure drinking water. The Department is required to establish safeguards against the hazards of impure water supplies, including minimum standards for construction of well pits. The Department has general control of all methods of obtaining groundwater and of the construction of wells. The Department of Resource Development may exercise such powers as are necessary to enforce these provisions. It may: employ needed personnel, conduct investigations and experiments concerning the cause of groundwater pollution, make inspections, and require persons responsible for water supply to determine the purity of that water. All those engaged in well drilling and pump installing shall register with the Department and pay permit fees. Competent sanitary engineers and superintendents of waterworks systems are exempt from registration. Penalties for registration violations are provided. (Duss-Florida)
W70-02923

**ECONOMICS OF SPLIT-TREATMENT WATER SOFTENING,**
Department of Water, Dayton, Ohio.
Bruce S. Shuey.
American Water Works Association Journal Vol 58, No 1, p 107-112, Jan 1966.

Descriptors: *Economics, *Water softening, *Costs, Water treatment, Alkalinity, Benefits, Economic efficiency, Water quality.
Identifiers: *Split-treatment, *Single-stage softening, *Chemical costs, Soda ash, Carbon dioxide, Dayton (Ohio).

Split-treatment lime-soda water softening can be used under certian restricted conditions. The costs of this process, as opposed to single-stage softening, are compared and the former are found to be more economical. The three reasons for this are discussed and it was found that when a finished water with the minimum total alkalinity is produced and an average of 54 mgd is treated the annual savings amounted to more than $80,000. Modification in the method, resulting in a finished water which has aggressive characteristics, can still be accomplished with an annual saving of $55,000 at the same treatment rate. (Murphy-Rutgers)
W70-02989

**THE TECHNOLOGY OF PURE WATER.**

Presented at 7th Annual Liberty Bell Corrosion Course, Sept 16-18, 1969. Industrial Water Engineering, Vol 6, No 11, p 16-29, Nov 1969. 14 p, 13 fig, 3 tab.

Descriptors: *Water purification, *Demineralization, *Industrial water, *Water analysis, Quality control, Distillation, Filtration, Ion exchange, Water treatment, Pre-treatment (Water).
Identifiers: Deionization, Industrial ultrapure water.

Papers on quality requirements, preparation, and testing of ultrapure industrial water, presented at the 7th Annual Liberty Bell Corrosion Course sponsored by the National Association of Corrosion Engineers, 1969, are summarized. The main classes of contaminants to be removed and analyzed are particulate matter, ions, and organic material. Tests must be performed on flowing water in the system's output, because storage for any time will alter water quality. The classic pure water system consists of the following steps: (1) coagulation (with or without lime softening depending on the raw water available) and superchlorination; (2) granular bed filtration (sand); (3) activated carbon absorption and dechlorination; (4) ion exchange demineralization; (5) mixed-bed polishers includ-

ing final polishing demineralizers (usually the non-regenerable type); (6) roughing final filters or pre-filters (1-20 micron pore size); and (7) final polishing filters (0.3 - 0.8 micron pores). Conductance is undoubtedly the most commonly used measure of water quality. Even small laboratory units containing only 0.1 cu ft of resin for deionization are routinely equipped with some sort of conductance meter for monitoring water quality. Conductance meters capable of measuring down to the 0.01 - 1.0 micromho range are fairly inexpensive when compared to the cost of the average analytical instrument. Continuous measurement, accuracy, reproductibility, and ability to measure in the desired range all make conductance a common choice for monitoring water quality. (Knapp-USGS)
W70-03078

## 5G. Water Quality Control

### COMBATTING WATER POLLUTION FROM LARGE OIL SPILLS,

George E. Ferguson.
AWWA J, Vol 61, No 12, p 678-680, Dec 1969. 3 p, 13 ref.

Descriptors: *Water pollution sources, *Oily water, *Legislation, *Water works, Oil, Oil industry, Oil wastes, Water pollution treatment, Administrative agencies, Fouling, Taste, Odor, Ships, Pipelines, Water supply, Public utilities, Water consumption, Water distribution, Streams, Lakes, Federal government, State governments, Local governments, Project planning.
Identifiers: *Water Pollution Control Act, *Oil spills.

The problem of water supplies polluted by oil spills was studied by Committee 2500R of the American Water Works Association. The Committee report revealed extreme incidents of oil spills and considered measures currently underway to protect water supplies. Polluting oil most frequently results from faulty petroleum pipelines. The federal government now requires pipeline companies to report every such major accident. These reports indicate the causes of the problem and assess the damage. As a result of this analysis, government emergency teams are being established to deal with major spills into navigable waters. Federal, state, and local governments will participate in this program which is designed to warn water utilities of spills and prevent oil from reaching the raw water intakes. The Federal Water Pollution Control Act is being revised to deal more effectively with oil spills, especially those from offshore tankers. It also provides penalties for vessels discharging oil. The Committee report indicates that water utilities have handled the emergencies well and have prevented lengthy breakdowns of water production. The Committee further recommends the preparation of a manual for use by water utilities on how to deal with and prevent oil spill emergencies. (Dearing-Florida)
W70-02895

### STATE ACTIVITIES,

Richard S. Nelle.
Am Water Works Ass'n J, Vol 53, No 6, p 857-861, July 1961, 5 p, 7 ref.

Descriptors: *Illinois, *Water pollution, *Water pollution control, *Pollution abatement, State governments, Local governments, Legislation, Water rights, Riparian rights, Natural use, Natural flow doctrine, Reasonable use, Artificial use, Riparian lands, Groundwater, Percolating water, Eminent domain, Public health, Domestic water, Industrial water, Recreation, Watershed management, Waste disposal, Planning, Inter-agency cooperation, Water quality control.

The common-law water rights doctrine has been interpreted in Illinois by the natural flow and reasonable use theories. Stream pollution control laws have adopted the reasonable use theory. In other considerations of water rights, the natural flow theory has prevailed in diversion questions whereas the reasonable use is more frequently applied in consumption problems. Because water pollution knows no political boundaries, development in this area must come from state governments. With an expanding industrial economy and a greater competition for water use, pollution control cannot be attained without control of use. Any use of water involves a change in water quality, and this quality needs to be managed with increased precision as the quantity of water diminishes. Although the control of pollution is administered at the state level, local governments must exercise the authority granted to them to plan, construct, and police water sources. Control of watershed pollution is a cooperative venture. Cooperation must exist between local and state governments and among state agencies. Specific interests on the local level and on the state level are discussed. (Schram-Florida)
W70-02896

### DISCHARGING NOXIOUS MATTER INTO HIGHWAYS AND SURFACE WATERS.

Wis Stat Ann sec 146.13 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water pollution, *Sewage, *Highways, Surface waters, Drainage water, Drains, Pipes, Septic tanks, Cesspools, Outlets, Sewers, Discharge, Ditches, Wells, Cities, Abatement, Legislation, Regulation, Control, Domestic wastes, Legal aspects, Administrative agencies.
Identifiers: *Penalties (Criminal), Pumpage, Noxious matter, Sanitary District Commission.

Discharge of noxious matter into public highways through drains, pipes, sewers, or other outlets is prohibited. Local boards of health, town sanitary commissions, or county boards of health may order the offender to remove the discharged matter within ten days, and if such condition continues or recurs, cause its removal themselves. The cost shall be charged to the offender either by direct charges or by a municipal tax lien on the offender's lands. Recovery of such costs from railroad lands and other lands not taxed in the usual manner shall be effected through the state treasury. Persons maintaining such nuisances are subject to fine and imprisonment. No person shall discharge in any manner untreated domestic sewage into surface waters nor shall he discharge effluents or pumpage from septic tanks, dry wells, or cesspools into surface waters. Persons committing such offenses are subject to fine and imprisonment. (Duss-Florida)
W70-02912

### GENERAL MUNICIPALITY LAW DEALING WITH SEWERAGE SYSTEMS.

Wis Stat Ann secs 66.076-66.078 (1965).

Descriptors: *Wisconsin, *Sewage disposal, *Sewage treatment, *Treatment facilities, Disposal, Environmental sanitation, Sewers, Sewage, Local governments, Legislation, Legal aspects, Waste water treatment, Water utilization, Water rates, Domestic wastes, Municipal wastes, Cities, ydrants, Water works, Regulation, Public utilities.

Any city may construct, acquire, or lease any plant or equipment for the collection, disposal and treatment of sewage. Purchase of these facilities is to be financed through taxation or bond sales. Such bonds are not a general indebtedness of the municipality, but are secured only by the sewage facilities. (Barnett-Florida)
W70-02917

### OPEN PIT MINING.

Pa Stat Ann tit 52, secs 1396.1, 1396.4 (1966).

Descriptors: *Pennsylvania, *Mine drainage, *Coal mining, *Water pollution sources, Mine wastes, Mine acids, Acid mine water, Coal mine wastes, Water pollution, Soil erosion, Backfill, Excavation, Drainage engineering, Ditches, Dikes, Legislation, Administrative agencies, Administrative decisions, Terracing, Soil conservation, Water conservation, Legal aspects, Surface drainage, Permits, Percolating water, Subsurface waters.

As an exercise of the police power, Pennsylvania regulates open pit mining to conserve and improve affected lands, protect wildlife, decrease soil erosion, and to aid in the prevention of the pollution of rivers and streams. In applying for a permit to mine coal, a detailed proposal showing the time, distance, and manner for backfilling must be included. Such proposal shall also show the manner in which the mine operator plans to divert surface water from draining into the pit. Terracing may be approved so long as no depressions exist to hold water which may percolate through the spoil and produce acid drainage. The operator shall be responsible for the prevention of stream pollution by acid drainage or avoidable siltation. Failure to adequately maintain such ditches, dikes, pumps, and drainage facilities as may be necessary to prevent water from accumulating in the pit, or to prevent stream pollution, or siltation shall render the operator liable to the sanctions and penalties of this act. The Department of Mines and Mineral Industries shall be the exclusive investigating, examining, reporting, and enforcement agent of the Sanitary Water Board in relation to this act. (Schram-Florida)
W70-02929

### THE USE OF PURE OXYGEN IN RIVER AND IMPOUNDMENT AERATION,

New Mexico State Univ., Las Cruces.
R. E. Speece.
Pap, 24th Purdue Ind Waste Conf, May 1969. 22 p, 11 fig, 11 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Oxygen, *Limnology, *Reaeration, Impoundments, Costs, Water quality, Rivers, Lakes, Reservoirs, Injection, Oxygenation, Bubbles, Hypolimnion, Sanitary engineering, Water pollution.
Identifiers: Oxygen exchange.

The application of a generalized finite-element method to the static and dynamic analysis of plate and shell structures is presented. The displacement formulation of the finite-element method is used. A particular form of generalized variational principle is used, admitting completely arbitrary displacement functions for an element. The form of the matrix equations is presented and the method of solution and the problem of dependent algebraic equations are discussed. Numerical results for a variety of polynomial displacement forms and continuity requirements are discussed. Limitations of the method are pointed out. (USBR)
W70-02955

### INSECTICIDES AND ALGAE: TOXICITY AND DEGRADATION,

Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Ontario Water Resources Commission, Div of Research Publication No 27, 1968. 26 p, 9 tab, 31 ref.

Descriptors: *Algae, *Algal control, *Algicides, Analytical techniques, Aquatic algae, Aquatic environment, Aquatic microbiology, Balance of nature, Bioassay, Chlorophyta, Environmental effects, Inhibition, Limnology, Pesticides, Pesticide removal, Pesticide residues, Physiological ecology, Phytoplankton, Phytotoxicity, Plankton, Pollutant identification, Sewage, Sewage disposal, Sewage lagoons, Sewage treatment, Stabilization ponds, Water pollution control, Water pollution effects, DDT.
Identifiers: Chlorella pyrenoidosa, Pesticide degradation, Sevin, Malathion, Acetone, Ethanol.

Relationships between three insecticides (DDT, Sevin and Malathion) and algae with respect to toxicity and degradation were investigated using materials obtained from a nearby waste stabilization pond and axenic cultures of Chlorella pyrenoidosa at pH 6.0 and 9.0. DDT exhibited no toxic properties to either system at concentrations up to 100 milligram/liter and was broken down only to a limited extent by algae. Malathion exhibited no persistent inhibitory effect to algae and appeared to be metabolized fairly readily in comparison to the other two insecticides studied. Sevin at 100 milligram/liter was more toxic to the mixed pond algae than to Chlorella. The toxicity of Sevin to Chlorella was more pronounced at pH 6 than at pH 9 (30 and 15% inhibition, respectively). The effect of Sevin could be detected at 0.1 milligram/liter, but increasing concentrats had little increased effectiveness. (Fitzgerald-Wisconsin)
W70-02968

**STUDIES ON CHEMICALS WITH SELECTIVE TOXICITY TO BLUE-GREEN ALGAE,**
Wisconsin Univ., Madison. Water Chemistry Lab.
George P. Fitzgerald, Gerald C. Gerloff, and Folke Skoog.
Sewage and Industrial Wastes, Vol 24, No 7, p 888-896, 1952. 1 fig, 6 tab, 7 ref.

Descriptors: *Toxicity, *Cyanophyta, *Chemcontrol, Eutrophication, Bass, Water pollution control, Minnows, Nuisance algae, Sunfishes, Algae, Daphnia, Lakes, Chlorophyta, Streams, Diatoms, Reservoirs, Cultures, Sewage effluents, Wisconsin, Algicides, Hydrolysis, Copper sulfate, Fishes, Herbicides, Midges, Pesticides.
Identifiers: *Selective toxicity, Chemical structure, 2,3-dichloronaphthoquinone, Microcystis aeruginosa, Aphanizomenon flos-aquae, Minimum lethal doses, Chu's media, Quinone derivatives, Alkyl substituted imidazolines, Biological activity, Quarternary, Ammonium compounds, Minimum lethal exposure, Phenanthroquinone, Madison (Wis), Elodea, Redox compounds, Ceratophyllum, Myrophyllum, Rhizoclonium, Photobiology.

Procedures used and results of toxicity tests of 300 organic chemicals to Microcystis aeruginosa, a bloom-producing cyanophyte (blue-green alga) are described. Many compounds were toxic in concentrations in the range 1-10 parts/millon (ppm); several quinone-like compounds are toxic below 1 ppm, and one, 2,3-dichloronapthoquinone, is lethal at concentrations of 0.002 ppm. Apparently selectively toxic to nuisance cyanophytes, it is nontoxic to most green algae and higher plants, and has no shortterm deleterious effects on some fishes and invertebrates even when present in excess of saturation concentrations. Further study of this compound to rule out injurious effects to desirable species after long exposures are recommended. Age of cultures of Microcystis influence its response to the compound; centrifuged cells from both 6-day and 19-day cultures were markedly less sensitive when resuspended in old medium. This effect was partially counteracted after fortification of old medium with nutrients. Estimates of minimum lethal exposures indicate that compound is effectively toxic after 8-10 minutes treatment of cells. Limited field tests in barrels, tanks, and lagoons, containing dense growths of nuisance algae, principally Aphanizomenon flos-aquae, in lake water or sewage effluent, indicate that compound is effective in low concentrations (0.01-0.1 ppm). (Eichhorn-Wisconsin)
W70-02982

**A REVIEW OF CHEMICAL MEASUREMENTS IN WATER POLLUTION CONTROL,**
Federal Water Control Administration, Washington, D.C. Div. of Pollution Surveillance.
For primary bibliographic entry see Field 05A.
W70-02984

**POLLUTION ABATEMENT IN THE RUHR DISTRICT,**
Harvard Univ., Cambridge, Mass.
G. W. Fair.
In: Comparisons in Resource Management, Baltimore, Johns Hopkins Press, p 142-171, 1961. 30 p, 1 map, 6 tab, 17 ref, 1 append.

Descriptors: *Pollution abatement, *Transportation, *Industries, *Waste water, *Taxes, Potable water, River basin, Canals, Boats, Streams, Government, Swamps, Watercourses, Reservoirs, Floods, Marshes, Sewers.
Identifiers: *Emschergenossenschaft, *Ruhr district.

This article deals with pollution abatement measures in the six river-basin associations of the Ruhr district. Urban and economic development in the region is explained as it relates to intensified competition for water, making the development and safeguarding of surface sources of drinking water and process water a primary concern. One river-basin authority has acted, without change, for over fifty years. This is the Emschergenossenschaft, whose history is briefly related in this article. The river-basin associations have served autonomously, levying assessments and distributing benfits policies with the approval of both private and public representatives. These associations are unique in obtaining compliance with their prescriptions through thorough representation, and their power to plan, design, build and operate needed installations for pollution abatement. This article discusses a smoothly functioning and effective pollution abatement system that will be of interest to those working in water pollution problems. (See Vol 2, No 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03021

**AGRICULTURAL CHEMICALS AND OUR WATER RESOURCES,**
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Entomology.
For primary bibliographic entry see Field 05B.
W70-03065

**SUMMARY OF WATER QUALITY STANDARDS FOR THE INTERSTATE WATERS OF ARKANSAS.**
Federal Water Pollution Control Administration, Washington, D.C.

Federal Water Pollution Control Administration-Arkansas Pollution Control Administration Cooperative Report, Oct 1969. 21 p, 1 fig, 2 tab.

Descriptors: *Water quality act, *Water quality, *Standards, *Arkansas, Legislation, Water pollution, Water pollution control, Sewage treatment, Interstate, Water utilization.
Identifiers: *Arkansas water quality standards.

Arkansas adopted standards for its interstate waters on May 26, 1967, which were then submitted to the Department of the Interior. Subsequently, certain revisions were made by the State in the original standards, and the Secretary of the Interior approved the standards, as revised, on August 7, 1967. At the request of the Secretary of the Interior, Arkansas adopted a policy to protect its high quality waters. The approved standards are thus both State and Federal Standards, enforceable under the Arkansas water pollution control statutes and the Federal Water Pollution Control Act, as amended (Section 10). The standards consist of three major components: designation of the uses which the waters are to serve, specification of narrative and numerical criteria to protect and enhance water quality, and specification of a plan of implementation and enforcement, which includes treatment and control requirements for municipal, industrial and other wastes discharged to or affecting the waters. (Knapp-USGS)
W70-03083

**WATER AVAILABILITY IN URBAN AREAS OF THE SUSQUEHANNA RIVER BASIN - A PRELIMINARY APPRAISAL,**
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 04B.
W70-03102

**ILLINOIS WATER POLLUTION AND WATER RESOURCES COMMISSION, REPORT AND RECOMMENDATIONS TO GOVERNOR RICHARD B. OGILVIE AND THE 76TH ILLINOIS GENERAL ASSEMBLY.**
Illinois State Water Pollution and Water Resources Commission, Chicago.

State of Illinois Water Pollution and Water Resources Commission, Final Report, May 1969. 8 p, 1 fig.

Descriptors: *Illinois, *Water pollution, *Water resources, DDT, Chlorinated hydrocarbon pesticides, State governments, Water law, Legal aspects, Planning, Water resources development.
Identifiers: *Illinois Water Pollution and Water Resources Commission.

Beginning with a history of the Commission, recommendations from two previous Commission Reports, the 1967 report and the 1968 special report on Lake Michigan, were reviewed. Recent activities of the Commission were summarized also. The report concluded with four major recommendations for the 76th General Assembly: (1) A natural resource, or a water resource development, or a pure waters bond act should again be passed to be placed before the people of Illinois; (2) An effective system of controls should be placed on the use of DDT and possibly on all chlorinated hydrocarbons that present a substantial danger to wildlife and possibly to human beings when in concentration; (3) A restructuring of State government should be placed in effect at the earliest possible time for greater effectiveness in administering, managing, and coordinating controls and assistance for water and other natural resources. Preferably a Department of Natural Resources should be created; and (4) Illinois water laws should be reviewed and combined in a Water Code. (Davis-Chicago)
W70-03138

**ELECTRONICS STARTS SOLVING THE PROBLEMS OF THE CITIES,**
For primary bibliographic entry see Field 07B.
W70-03139

**LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.**
Illinois State Sanitary Water Board, Springfield.
For primary bibliographic entry see Field 05A.
W70-03140

**COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,**
Chicago Bureau of Engineering, Ill.
Clint J. Keifer, A. L. Tholin, and Marshall Suloway.
Chicago, City Bureau of Engineering, Department of Public Works, Sept 1969. 43 p, 13 fig, 6 tab.

Descriptors: *Underground storage, *Tunnels, *Control structures, *Sewers, *Flood control, *Water pollution control, Water conveyance, Waste water, Shafts, River regulation, Drainage systems, Drainage engineering, Design, Underflow.
Identifiers: *Chicago, *Metropolitan Sanitary District of Greater Chicago, Underflow storage plan.

Three alternative plans, proposed locally as solutions to flood control and pollution problems in the Chicago metropolitan area, are described and compared. The combined sewer systems, which carry the municipal and industrial wastes as well as storm water runoff, spill raw sewage into the Des Plaines, Chicago and Calumet Rivers and the Sanitary and Ship Canal from 400 outlets, during overflows occuring when interceptor sewers and treatment plants are loaded beyond capacity. The flow from these rivers empty via the Des Plaines River into the Illinois River. Intense rainstorms frequently

result in basement and underpass flooding. The $650 million plan suggested by the City proposes the construction of 95 miles of huge conveyance tunnels, 26 ft wide and 50 ft deep, excavated through solid rock beneath the Chicago, Calumet, and Des Plaines Rivers and the Sanitary and Ship Canal. Flows from the combined sewers would be dropped through shafts into these tunnels to provide temporary storage for flood prevention and to collect sewer overflows for subsequent pumping to three major existing treatment plants. Improvements along the Des Plaines River and the Sanitary and Ship Canals planned by the Illinois Division of Waterways are also described. The project design would be based upon handling the runoff from a storm with a 100 year average recurrence interval. (Poertner-Chicago)
W70-03142

**EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,**
Quirk, Lawler and Matusky, New York.
For primary bibliographic entry see Field 05B.
W70-03165

**WATER QUALITY PLANNING IN THE PRESENCE OF INTERACTING POLLUTANTS,**
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 05B.
W70-03168

**TRANSPORT OF DISSOLVED WASTES IN RIVERS,**
Federal Water Pollution Control Administration, Washington, D.C.; and Texas Univ., Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 05B.
W70-03174

**PUBLIC HEALTH: DISPOSAL OF WASTE BY MUNICIPALITIES AND INDIVIDUALS THROUGH SEWAGE SYSTEMS.**

Wis Stat Ann secs 144.05-144.07, 144.09, 144.10 (1957), as amended, (Supp 1969), 144.045, 144.14 (Supp 1969).

Descriptors: *Wisconsin, *Sewage disposal, *Sewage treatment, Administrative agencies, Water pollution, Watersheds, Cities, Streams, Lakes, Legal aspects, Treatment facilities, Conduits, Public health, Effluents, Refuse, Regulation, Drainage basins, Buildings, Sewerage, Sanitary engineering, Discharge, Legislation, Water treatment, Waste treatment, Water quality control.
Identifiers: *Enforcement, Penalties (Civil).

The outflow or effluent from sewage systems complying with section 144.04 may be discharged into any stream or drain constructed pursuant to law. No such outflow of untreated sewage may be discharged into lakes of a delineated size from a city in a county with a population of at least 240,000, any part of which is located within a drainage basin which drains within a minimum distance from the sewage systems. All necessary construction of plant facilities for the discharge of untreated sewage shall be completed by September 1, 1970. Advanced treatment of effluent may exempt owners of existing plants from these provisions. Municipalities with populations of more than 7,500 may require buildings used for human habitation to be connected with adjacent sewers or water mains. Penalties are provided for failure to comply. The Department of Resource Development may require the planning and construction of sewerage systems so that they may be connected. Adjacent municipalities may operate a joint system. Procedures for administering such a system are outlined. The Department of Resource Development is empowered to enforce its rules. Individual owners may secure a review of any order issued by the Department. (Duss-Florida)
W70-03189

**WATER, ICE, SEWAGE AND REFUSE.**

Wis Stat Ann secs 144.01-144.02, 144.04 (1957), as amended, (Supp 1969) 144.023-144.03 (Supp 1969).

Descriptors: *Wisconsin, *Water quality control, *Water pollution, *Sewage, Water supply, Water resources, Water quality act, Legislation, Water resources development, Water pollution control, Public health, Water treatment, State governments, Administration, Septic tanks, Sewage disposal, Sewage treatment.

The following terms are defined for purposes of this act: waters of the state, sewage, waterworks or water systems, water supply, sewerage systems, refuse, owner, industrial wastes, and pollution. The Department of Water Resources is authorized to act with the United States Geological Survey to determine the condition of polluted and unpolluted waters, the causes of pollution, including city sewage and industrial wastes, and the best sources of water supplies. Governmental owners must submit plans for sewerage systems to the Department of Water Resources for approval. A Department of Resource Development containing a Water Resources Division is created. The Department seeks to protect, maintain and improve the quality and management of the state's ground and surface waters. The purpose of this act is to centralize programs of water quality management in a single agency empowered to develop a comprehensive plan for protection of the public and private waters of the state. A State Water Resources Advisory advises the Department. The Department must divide the state into regions, each to be served by a regional director and regional advisory board. The installation of septic tanks is regulated. (Dye-Florida)
W70-03199

**POLLUTION CONTROL: STANDARDS FOR SOLID WASTE DISPOSAL.**
Wis Stat Ann secs 144.31, 144.43-144.46 (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Solid wastes, *Waste disposal, Air pollution, Ultimate disposal, Water resources, Water management, Atmosphere, Industries, Standards, Construction, Flood plain zoning, Permits, Investigations, Landfill, State jurisdiction, Federal government, Shores, Research and development, Design, Treatment facilities, Pollutants, Regulation.

The Department of Resource Development shall have the power and duty to: promulgate rules; encourage local governments to handle local pollution problems; and organize a comprehensive program to improve and manage the state's air, land, and water resources. The Department may hold hearings, issue orders, secure necessary services, conduct investigations regarding emission from motor vehicles, and advise, consult, and cooperate with other appropriate governmental and private bodies. By January 1, 1969, the Department shall prepare and adopt minimum standards for the location, design, construction, sanitation, operation, and maintenance of solid waste disposal sites and facilities. Annual licensing of sites and facilities is required in order to secure compliance with these minimum standards. Local governments may apply more restrictive licensing standards. The Department may conduct research into matters concerning solid waste disposal. Unless authorized by the Department, solid waste disposal sites and facilities are prohibited within areas under the jurisdiction of shoreland and flood plain zoning regulations. (Duss-Florida)
W70-03202

**CREATION OF TOWN SANITARY DISTRICTS FOR POLLUTION CONTROL AND WASTE DISPOSAL.**
Wis Stat Ann secs 60.30-60.304 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Drainage systems, *Waste disposal, Sewers, Sewage disposal, Sewage treatment, Drainage, Storm drains, Water works, Cities, Pumping, Construction, Jurisdiction, Real property, Public health, Legal aspects, Treatment facilities, Domestic wastes, Boundaries (Property), Sewage districts.
Identifiers: *Sanitary districts.

Town sanitary districts may be created for the purpose of purchasing, establishing, or constructing surface or storm water sewers, drainage improvements, sanitary sewers, or a system of waterworks, sewerage, or garbage disposal. The districts may sue and be sued in furtherance of these purposes. 'Sewerage' includes all construction for collection, transportation, pumping, treatment, and final disposition of sewage. Procedure for creation of a town sanitary district is set forth. Town districts may be created within metropolitan sewerage districts since it is the intention of the legislature to permit auxiliary sewer construction in addition to the main and intercepting sewers constructed by metropolitan districts. Town boards are vested with jurisdiction to establish town sanitary districts. Petitions requesting such districts must be submitted by a fixed percentage of affected landowners to the town boards. Open hearings must be held by the town board before the creation of a district can be approved. Judicial review of the board's action is made available. (Duss-Florida)
W70-03203

**MUNICIPAL CORPORATIONS.**
For primary bibliographic entry see Field 03D.
W70-03206

**REGIONAL WATER AND SEWER DISTRICTS.**

Ohio Rev Code Ann secs 6119.01, 6119.06 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Sewage districts, *Water supply, *Sewage disposal, Legislation, Legal aspects, Contracts, Leases, Regulation, Easements, Water purification, Sewage treatment, Construction, Maintenance, Operating costs, Drains, Dams, Reservoirs, Pumping plants, Cost allocation, Taxes, Assessments, Industrial wastes, Eminent domain, Canals, Compensation, Administrative agencies.

Specified areas may be organized as regional water and sewer districts for either or both of the following purposes: (1) to provide a water supply for domestic, industrial, and public use; or (2) to provide for the collection and disposal of sewage and other liquid wastes. Regional water and sewer districts are authorized to make regulations governing the control and operation of their services and facilities and to acquire or operate sewer systems, waterworks, filtration and purification plants, and sewage treatment plants. The districts may construct, acquire, and maintain drains, dams, sewers, reservoirs, holding basins, wells, intakes, pipelines, purification works, septic tanks, treatment and disposal works, and pumping stations. In addition, the districts have the following powers: to levy and collect taxes or special assessments; to deal in real or personal property and franchises to carry out the purposes of the district; to merge or combine with any other district to form a single district; to contract with any other political subdivision for the joint construction of any works they are authorized to construct; and to construct or alter any ditch, drain, or watercourse. (Keith-Florida)
W70-03210

# 06. WATER RESOURCES PLANNING

## 6A. Techniques of Planning

**OPERATIONS RESEARCH IN OUTDOOR RECREATION,**
Battelle Memorial Inst., Columbus, Ohio.

Frank J. Cesario, Jr.
Journal of Leisure Research, Vol 1, p 33-51, Winter 1969. 19 p, 7 fig, 21 ref.

Descriptors: *Operations research, *Recreation, Population, Administration, Benefits, Highways, Regression analysis, Demand schedule, Supply, Demand.
Identifiers: Recreational travel flow, Recreation system, Population centers, Recreation sites, Gravity models, Linear systems analysis, Clawson-Knetsch technique.

A major concern of public administration is how to provide enough outdoor recreation services to satisfy the recreation-seeking public. Assuming that more recreation sites are to be provided, the problem becomes one of deciding what facilities to provide and where to locate them. To answer these questions rationally and to properly allocate the limited funds available, the economic benefits of various alternative projects need to be estimated. This problem can be studied by the methods of operations research. Work to date has shown an interesting dichotomy. Some analysts (mostly operations researchers) have been developing models to predict recreational travel flow. Other analysts (mostly economists) have been working on problems relating to the economic benefits of outdoor recreation developments. The purpose of this paper is threefold: first, the work of the two groups studying outdoor recreation is reviewed; second, it is shown that we cannot conveniently separate the estimation of benefits from the estimation of recreation travel flow, and third, some suggestions for new directions of research are given. The importance of water resources in outdoor recreation make this article of interest to the water planner. (Loeb-Rutgers)
W70-02987

**A NOTE ON 'GRAPH-THEORETICAL APPROACHES TO THE THEORY OF SOCIAL CHOICE',**
Resources Management Corp.
George M. Lady.
Public Choice, Vol 6, p 93-98, Spring 1969. 6 p, 4 ref.

Descriptors: Social aspects.
Identifiers: *Graph-theoretical approaches, *Social choice, Ranking, Intransitivity, Interpersonal comparisons, Quantitative problems.

The author discusses a method introduced by Professor M. Taylor for considering the problem of combining individual rankings. More specifically, Professor Taylor proposed an ingeneous application of graph theory to the problem of combining individual rankings into a group ranking. This note provides three classes of commentary. First, the analytical relationship between the structure of the individual rankings and the existence of intransitivity is somewhat consolidated. Second, certain quantitative difficulties are identified. Last, the problem of interpersonal comparison is reopened in the context of the computational scheme suggested by the paper. The author concludes that the graph theoretical approach is extremely useful although it does not entirely escape the problem of inter-personal comparisons. The problems of group decisions and interpersonal comparisons are present in water investment decisions and this article will be of interest to water researchers investigating decision processes and decision effects of water development projects. (Loeb-Rutgers)
W70-02992

**THE INVESTMENT DECISION UNDER UNCERTAINTY,**
Donald Eugene Farrar.
Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1962. 90 p.

Descriptors: *Investment, *Risks, Decision making, Return.
Identifiers: *Investment decision, Expected return, Certainty equivalence, Mathematical programming, Classical utility theory, Collinearity, Portfolios, Goodness of fit test, Capital theory.

Both the importance and the generality of uncertainty require that it be built into any theory that purports to explain a large portion of man's behavior. Economists have long been conscious of the need to more adequately account for its effect on such decision making units as the consumer and the firm. Capital theory, in particular, has felt the inadequacy of theories which ignore uncertainty's role in the investment decision. The author proposes to build a model so as to analyze decision making under uncertainty. This approach relies on only two substantive proposals: (1) an investor's utility of money function is positively sloped and concave downward, and (2) his investment strategy is the maximization of expected utility. The model is a direct descendant of classical utility theory. It can also be linked to the certainty equivalence tradition of risk aversion. Finally, it is also a mathematical programming approach to decision making under uncertainty. The model appears to describe the portfolio policies of mutual funds quite well. It is probable that with additional constraints, its applicability as a model of the investment decision under uncertainty may be quite general. If this is the case, such a model should prove quite useful in the water area where investment decisions are made with uncertainty and risk. (Loeb-Rutgers)
W70-03003

**ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,**
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
For primary bibliographic entry see Field 06B.
W70-03091

**COMPUTER SIMULATION PROGRAMMING: AN AID TO THE SELECTION AND MANAGEMENT OF CENTER PIVOT SPRINKLER SYSTEMS,**
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03162

**IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,**
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
L. V. Dunin-Barcovsky.
The Use of Analog and Digital Computers in Hydrology, Vol 2, p 682-686, 1969. 5 p, 4 ref.

Descriptors: *Mathematical models, *Water resource development, *Optimization, *Planning, *Linear programming, Stochastic processes, Water works, Reservoirs, Multiple-purpose, River basins, Computers.
Identifiers: Operating schedules.

The development and use of linear and non-linear programming techniques and mathematical models for optimum planning and management of water resources in the USSR were discussed. The stochastic nature of the initial parameters of water works systems enabled the collection of reliable data about possible strategy and tactics for an optimum control which was necessary for the determination of optimum system parameter. The use of such characteristics as operating schedules for water reservoirs and water supply to consumers was an important element of optimum control. The optimization of operational systems was aimed at selecting optimum parameters and the operational system was used for modelling the operational process with the purpose of determining the optimization degree received. The management of the multiple-purpose Zeravshan river basin was given as an example. Computers were employed for data processing. (Thiuri-Cornell)
W70-03166

**NEW METHODS FOR USING STOCHASTIC PROCEDURES IN WATER RESOURCE PLANNING,**
Computer Technology, Inc., Arlington, Tex.
Jerry R. Rogers, and Ronald L. Boase.
Report to Tex Water Develop Board, Computer Technol Inc, Math-Sci Sect, Sept 1969. 45 p, 9 fig, 12 tab, 24 ref.

Descriptors: *Stochastic processes, *Synthetic hydrology, *Water resources development, *Planning, *Streamflow forcasting, *River basins, Hydrological data, Reservoir operation, Economics, Mathematical models.
Identifiers: Linear regression models.

Current stochastic models as well as a discussion on proper procedures for generating data for use in testing alternative plans for river basin improvement were presented. Existing data sources for Texas Water plan and their utilization in the stochastic models were reviewed. Linear regression models for relating the streamflow in one time period to a linear function of the flow in preceeding time period were compared. The Weibull distribution was considered as a possible candidate for filting hydrological data. To test the applicability of the Weibull distribution to meaningful data the historical flow rates for the Salt Fork branch of the Brazos River was selected. At least nine to ten random sets of 50 or 100 years of stochastic data would be applied to the Texas Water Plan reservoir-transmission analysis to provide; (a) experience on system economic and physical performance under a wide variety of potential streamflows and; (b) measures of the risks involved for various reservoir-transmission capacities and construction dates. (Thiuri-Cornell)
W70-03171

**MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,**
Nevada Univ., Reno. Center for Water Resources Research.
W. S. Butcher.
The Use of Analog and Digital Computers in Hydrology, UNESCO, Vol 2, p 714-723, 1969. 10 p, 23 ref.

Descriptors: *Mathematical models, *Optimization, *Resource allocation, *Linear programming, *Dynamic programming, Simulation analysis, Stochastic processes, River basins, Monte Carlo method, Hydrologic data, Hydro-electric power, Streamflow forecasting, Water storage.

The use of linear and dynamic programming techniques in various mathematical modeling methods capable of determining the optimal allocation of available water was discussed. To illustrate the alternative methods and their limitations, a river basin was examined. It was clear that if historical or known hydrological data was available, the optimum operation of a reservoir could be calculated directly by either linear or dynamic programming. However, if hydro-power was involved the linear programming formulation became clumsy and was not the best choice. Even without this, dynamic programming was to be preferred as it was simpler more direct and involved less computation. Dynamic programming under stochastic condition whether the Monte Carlo method or the true stochastic dynamic programming was superior to the alternatives available in streamflow determination and management. Simulation was essentially a 'what if' process, that is, for its use it was necessary to specify a proposed operating rule and see what happened if it was used. (Thiuri-Cornell)
W70-03173

**USE OF SYSTEMS ANALYSIS METHODS IN DETERMINING NEEDS AND IMPLEMENTING PROGRAMS FOR WASTE TREATMENT FACILITIES.**
Federal Water Pollution control Administration, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-03176

## 6B. Evaluation Process

**DELAWARE RIVER COMPACT.**

Pa Stat Ann tit 46, sec 251 (1969).

Descriptors: *Pennsylvania, *Delaware River, *Regulated flow, *Water conservation, Legislation, Municipal water, Domestic water, Interstate rivers, Interstate compacts, River basins, New York, New Jersey, Water resources, Water utilization, State governments, Equitable apportionment, Legal aspects, Water supply, Beneficial use.

The Governor may appoint three commissioners to negotiate a compact with duly authorized agents of New York and New Jersey. The compact is for the regularization of the flow of the Delaware River, the conservation of the water resources of the Delaware Basin, the apportionment of these water resources for domestic and municipal supply, and the utilization thereof for power and other beneficial uses. (Schram-Florida)
W70-02932

**ATLANTIC STATES MARINE FISHERIES COMMISSION.**
Pa Stat Ann tit 30, secs 411-414, 417 (1958).

Descriptors: *Pennsylvania, *Interstate compacts, *Interstate commissions, *Marine fisheries, Water resources development, State governments, Administrative agencies, Cost allocation, Federal government, Political aspects, Leadership, Fish stocking, Legislation, Planning, Surveys, Investigations, Legal aspects, Research and development, Atlantic Coastal Plain, Fish conservation, Marine fish, Anadromous fish, Shellfish, Coordination.
Identifiers: Atlantic states.

The Governor of Pennsylvania is authorized to execute the Atlantic States Marine Fisheries Compact. The purpose of such compact is to promote the better utilization of the marine, shell, and anadromous fisheries of the Atlantic seaboard, by the development of a joint program for the promotion, protection, and prevention of physical waste of such fisheries. Each state joining shall appoint representatives to the Atlantic States Fisheries Commission which shall be constituted and organized as herein provided. The Commission shall have the powers and duties to: (1) conduct studies; (2) recommend coordination of the police powers of the several states; (3) recommend legislation; (4) advise state administrative agencies; and (5) recommend the stocking of waters. The states joining the Compact agree to make annual appropriation to the support of the Commission. The initial annual appropriation is set forth for each state. The Fish and Wildlife Service of the Department of the Interior of the United States shall act as the primary research agency of the Commission. Pennsylvania officers and bureaus are directed to cooperate with the Commission. (Marsee-Florida)
W70-02935

**PLANS FOR MULTIPLE USE OF THE WATER RESOURCES IN THE LENA RIVER,**
F. V. Iarosh.
Gidrotekh Stroit, No 1, p 1-8, 1966. Transl from Russ, Bur Reclam Transl 694, Oct 1969. 31 p, 5 fig, 5 tab.

Descriptors: Water resources, Project planning, Earth dams, Cold weather construction, *Multiple-purpose projects, Multiple use, Optimum development plans, Preliminary investigations, Foreign projects, *River basin development, Permafrost, Engineering geology, Dams, Hydroelectric plants, Feasibility studies, Hydroelectric power.
Identifiers: Comparative studies, Hydroelectric resources, Lena River Basin (USSR), Lower Lena Powerplant (USSR), Resources development.

The Lena River Basin, producing the second largest river discharge in Siberia, can provide the USSR with multiple benefits if properly developed for full use of the water resources for navigation, power, industry, mining, and forestry. Geography, climate, hydrology, and engineering geology of the Lena and 5 main tributaries, the Kirenga, Vitim, Olekma, Aldan, and Viliui Rivers, are described. A map of the river basin shows 60 hydropowerplant sites, including alternatives. The earth dam alternative at the Lower Lean site with backwater up to Iakutsk is discussed. The plan includes an earth dam, diversion canal, tunnel spillway, tunnel penstocks, and powerplant on the left bank with an installed capacity of 20,200 mw and annual output of 98.5 billion kwhr/yr. Power will be transmitted 3,500 km through the Central Siberian Grid to the Ural industrial area, although future planning will include cost comparison of constructing power-consuming industries near the powerplant. Construction will be difficult because of the remoteness of the area, lack of transportation facilities, severe arctic climate, permafrost, large flow and swift deep current through the Lean narrows, and magnitude of the construction work. (USBR)
W70-02949

**WATER AS A RESOURCE AND AS A NUISANCE,**
Geological Survey, Menlo Park, Calif.
Harold E. Thomas.
Highw Res Rec, No 271, p 17-28, 1969. 12 p, 17 ref.

Descriptors: *Water resources development, *Water, Water resources, Water utilization, Benefits, Hydrologic cycle, Damages, Bibliographies, Statistics, Urbanization, Rainfall effects, Minerals, Surface runoff, Land resources, Flood protection, Wastes, Atmospheric precipitation.
Identifiers: Urban hydrology.

Water as a resource is available for use and enjoyment by mankind. Consumptive uses reduce the quantity, and nonconsumptive uses may impair the quality of water available for use by others; various laws protect the respective rights of individuals in water use. Although water rights are protected as property rights, recognition of rights of the public and responsibilities of water users for maintenance of satisfactory quality are increasing. Water may constitute a nuisance if it harms development of land resources and invades recognized property rights. Conversely, development of land resources may have effects that interfere with the water rights of others, causing a nuisance. In urban areas, water as a resource becomes increasingly inadequate to meet requirements of the population and must be imported, along with food, fuel, and other materials. Generally in urban areas, water supply and disposal of used water have become public responsibilities. Urbanization changes the hydrology of an area in total runoff, peak flow characteristics, water quality, and appearance of lakes, streams, and valleys. To predict, ameliorate, or otherwise cope with these changes, urgent need exists for additional research in urban hydrology. (USBR)
W70-02959

**ECONOMIC EVALUATION OF ENGINEERING PROJECTS,**
Canada Ltd., Toronto (Ontario).
W. B. Magyar.
Engineering Economist, Vol 13, No 2, p 67-85, Winter 1968. 19 p, 4 charts, 20 ref.

Descriptors: *Environment, *Decision-making, *Engineering, *Design, Investment, Capital, Economic feasibility, Optimization, Economic evaluation, Computers, Research and development, Management, Budgets, Risks, Costs, Water consumption, Taxes.
Identifiers: *Stage-wise approach, Cash-flow analysis, Public works projects, Project business model.

The economic and technical feasibility of engineering projects was studied. Economic evaluation in such projects has been inadequate due largely to the absence of a good general framework for probing economic feasibility. Improvement and standardization of economic evaluation would help industry and government cope with proposed capital expenditures. Preliminary estimates for such expenditures should be an integral part of broad planning within the total environment involved. The recommended approach is therefore a general and stage-wise one which will furnish such information to improve decision-making. The time and costs involved in such extensive economic evaluations will be offset by savings from rejections of unsound programs. This method is especially applicable to water resource projects, due to the important role they play in the total environment quality. (Murphy-Rutgers)
W70-02986

**ECONOMIC ANALYSIS OF PROJECTS FOR SECONDARY SOURCES OF WATER SUPPLY,**
Ford, Bacon and Davis, Inc., New York.
John L. Rose.
Journal of American Water Works Association Vol 54, No 11, p 1361-1369, Nov 1962. 9 p.

Descriptors: *Investment, *Water supply, Economic analysis, Technology, Water resource development, Costs, Capital, Computers, Optimization, Demand, Interest rate, Discount rate, Engineering, Benefits.
Identifiers: *Staged construction, *Capacity.

This article discusses the factors entering into the economic analysis of projects for secondary water supplies and into the techniques for making the analysis. The factors discussed are: (1) the capacity of the proposed improvement, including the firming effect on the primary source of supply; (2) the conjectural nature of the demand projections; and (3) the susceptibility of alternative plans to staged construction. The choice of the formula to be used for deciding between the design alternatives is discussed as well as the rate of interest to be used to place events occurring at different times on a common basis. The author finds that the general tendency of the factors studied is to reduce the initial investment and to incur higher operating costs in the later stages of development. (Murphy-Rutgers)
W70-02990

**ASSESSING THE DEMAND FOR OUTDOOR RECREATION,**
George Washington Univ., Washington, D.C.
Jack L. Knetsch.
Journal of Leisure Research, Vol 1, No 1, p 85-87, Winter 1969. 3 p.

Descriptors: *Recreation demand, *Demand, *Recreation, Recreation facilities, Investment, Planning, Population, Prices, Supply.
Identifiers: Participation.

Due to increases in the use of recreation facilities, large investments are being made in this area and planning efforts are needed to improve the allocation of these investments. However, there is a lack of appropriate studies designed to guide these planning efforts. The author argues that outdoor recreation demand studies are often used in an inappropriate and incorrect manner. Problems are introduced by the methods which population data are employed. Recreation demand has often been used misleadingly due to the confusion of the recreation 'demand' terminology. Ambiguity enters principally at two points which make many so-called demand studies nearly useless as guides to planning recreation investment: The first is based on the premise that price-quantity relationships which lie behind the concepts of demand and supply should be ignored. A second difficulty is that so-called 'demand' is not demand at all. Often participation rates are influenced by both demand and availability of supply. The author argues that the single most serious and fundamental deficiency in demand surveys and studies is that they do not provide any means of determining how recreation use will respond to changes in supply. Recreation demand studies, to be useful for planning purposes must consider the effect of both demand and

supply factors on recreation use. The crucial role of water in outdoor recreation and the dollar benefits assigned to recreation in water projects make this article relevant to the water area. (Loeb-Rutgers)
W70-02993

**A RESOURCE ECONOMIST VIEWS A NATURAL AREA,**
Vermont Univ., Burlington.
Frederic O. Sargent.
Journal of Soil and Water Conservation, Vol 24, No 1, p 8-11, Jan-Feb 1969. 4 p.

Descriptors: *Resource allocation, Economic impact, Resource development, Decision making, Political aspects, Planning, Cost-benefit analysis, Economics.
Identifiers: *Resource economist, *Natural area, Free market, Economic principles, Economic methods, Opportunity costs, Resource development potential, Economic impact analysis.

Economists concern themselves with objective studies of costs, returns, benefits, allocation of cost, efficiency of resource use and resource distribution. All of these subjects have a bearing on decisions concerning natural resources. The author discusses the difference between resource economists and other economists. The difference hinges on the concept of the dominant resource allocating mechanism. Nonresource economists, be they specialized in production, marketing, business, investments, or other areas have one thing in common: They are all devoted to the proposition that the free market is the prime resource allocating mechanism in our society and that it handles the job of allocating resources well. The resource economist is devoted to the proposition that the political process in which government action at various levels controls, guides, and regulates the use of natural resources is the prime allocating procedure with respect to natural resources. The author continues by discussing how the resource economist views a natural area. He studies a natural area with reference to basic principles and by methods developed over a period of time that have been shown to be useful in making resource allocation decisions. These principles and methods are of two kinds, (1) planning and (2) economic principles and methods. (Loeb-Rutgers)
W70-02994

**STRATEGIC INTERACTION AND RESOURCE ALLOCATION IN METROPOLITAN INTERGOVERNMENTAL RELATIONS,**
Massachusetts Inst. of Tech., Cambridge.
Jerome Rothenberg.
AER, Vol 59, No 2, p 494-503, May 1969. 10 p.

Descriptors: *Resource allocation, *Governments, Sites, Cities, Costs, Welfare.
Identifiers: *Strategic interaction, Metropolitan area, Suburbs, Privacy, Locational advantages, Public policy, Land value, Variable sum strategic game, Residential location decisions.

The model presented in this paper concerns the influence that local government in a metropolitan area has on the distribution of economic activities within the area. The basic situation here is that a single metropolitan area government does not exist but a set of independent political jurisdictions is present. In this model the area is assumed to be partitioned into a central city jurisdiction and a single suburban jurisdiction, both of constant area. Certain policy instruments controlled by these jurisdictions are assumed to influence the location decisions of households and business. The model indicates how these instruments are used in a way to exert conflicting influences on such decisions such that the respective opposing pulls are akin to a process of strategic interplay between two players in a variable sum strategic game. As such, this paper might provide insights on the influential effect of government actions on water resource investment projects conducted on a regional or interlocality basis. (Loeb-Rutgers)
W70-02995

**AN ECONOMIC THEORY OF SOCIAL MOVEMENTS,**
London School of Economics and Political Science (England); and Johns Hopkins Univ., Baltimore, Md.
Albert Breton, and Raymond Breton.
AER, Vol 59, No 2, p 198-205, May 1969. 8 p, 1 fig.

Descriptors: *Economics, Demand, Supply, Environment, Growth rates.
Identifiers: *Social movement, Socioeconomic factors, Demand for social change, Supply of social movements.

Social movements do not make their appearance at random; instead they tend to emerge in relatively well-defined circumstances and to be accompanied by identifiable socioeconomic factors. In this paper the authors develop a hypothesis about the origin of social movement. The paper is divided into three parts: the first elaborates a theory of the demand for social change or, more specifically, a theory about why the demand for change manifests itself in social movements. This first part, in turn, is subdivided into two sections examining: first, some structural components of the environment in which social movements originate and, second, the definitions and assumptions of the proposed theory as well as its essential mechanisms. The second part introduces the concept of the supply of social movements and examines how this supply is related to the demand for social change. This discussion sheds some new light on the question of social change itself. Social change and its political effects can have significant implications for the public goods area. Water resource development involves all the problems of the public sector and this article may be of general relevance to relating social and institutional factors into studies of water resources. (Loeb-Rutgers)
W70-02998

**ECONOMIC CONSIDERATIONS FOR THE DESIGN OF WATER INSTITUTIONS,**
Indiana Univ., Bloomington.
Jerome W. Milliman.
Public Administration Review, Vol 25, No 4, p 284-289, Dec 1965. 6 p.

Descriptors: *Economics, Administration, Institutions, Water allocation, Water management, Water resources development, Water law.
Identifiers: *Water institutions, Regional economic growth, Water crisis, Public agencies, Efficiency.

The problem of how best to allocate water resources should be viewed as part of an overall management problem in the use and development of water resources and not simply as a problem of allocation of water resources among competing uses. The problem of allocation needs is to be considered within a management framework which is capable of comprehending the major technological, hydrologic and economic relationships of water resource management. The allocation of water resources involves wise choice in all the uses of water and also efficient use of all complementary resources intimately related to water resource development and regional economic growth. Our water problems are largely ones of inadequate institutional arrangements for management of water resources and failure to use economic principles. Two alternatives are suggested for consideration in the choice of decision-making frameworks, the regional basin authority and greater use of the market system through improvement in water law. The author suggests that some combination of the two would be desirable and feasible for greatly improving the management of our water resources. (Loeb-Rutgers)
W70-02999

**THE USES OF ECONOMIC RESEARCH,**
National Bureau of Economic Research, New York.
Solomon Fabricant.
43rd Annual Report, National Bureau of Economic Research, NY, p 1-4, May 1963. 4 p.

Descriptors: *Economics, *Forecasting, Economic analysis, Measurement, Government, Taxes, Economic investigations, Social impact.
Identifiers: *Economic research, *Economic concepts, *Quantification, *Economic behavior, *Research aims, Economic policy.

Economic research is aimed at strengthening the ability of economics to better human life. Knowledge for its own sake is not the main objective of economic research. It should aim at: clarifying the concepts and terminology used in discussing economic problems; devising measurements that permit objective assessment of significant economic quantities; compiling significant information on economic facts; observing and explaining economic behavior; drawing implications of changes of structure in our economy; aid in forecasting and estimating the probable consequences of policies. Due to the importance of economic research in much of the water resource area, this general discussion of the purposes of research should be of interest to the water researcher. (Murphy-Rutgers)
W70-03001

**UTAH'S FUTURE WATER PROBLEMS,**
Wayne D. Criddle.
Utah, Utah State University, 1958. 19 p.

Descriptors: *Utah, Urbanization, Legal aspects, Social aspects, Water law, Water supply, Soils, Irrigation, Drainage, Water utilization, Water resources development.
Identifiers: *Water problems, Technical problems, Instruments, Water research.

Utah is rapidly changing from what was once predominately an agricultural state to an urban and industrial state. This shift is intensifying the water needs of the state and creating many new problems. These changes involve technical, legal, sociological and economic problems never before encountered. Before attempting to look at Utah's water problems of the future, the author reviews the developments that have taken place in the past. The author then discusses the areas of water laws, limited technical knowledge of water supply, knowledge of soils, irrigation facilities, water uses and research in water use and development. (Loeb-Rutgers)
W70-03004

**ADMINISTRATIVE DECISION MAKING,**
Carnegie Inst. of Tech., Pittsburgh, Pa.
Herbert A. Simon.
Public Administrative Review, Vol 25, No 1, p 31-37, Mar 1965. 7 p.

Descriptors: *Decision making, Administrative decisions, Administration, Operations research.
Identifiers: *Administrative decision making, Management science, Optimality, Persuasion, Evocation.

Decision-making concepts and language have become highly popular in papers concerning administration. This paper describes some of the progress that has been made over the past quarter century employing this approach towards furthering the scientific knowledge of what new facts have been learned about human behavior in organizations, what new scientific procedures have been developed for ascertaining facts, what new concepts have been made for describing and explaining these facts. This progress extends both to descriptive and normative matters: to the pure science of administration, and its application to the practical business of managing. As such, this article may present insights in administrative decision making applicable to the water area. (Loeb-Rutgers)
W70-03007

**TECHNOLOGY IN AMERICAN WATER DEVELOPMENT,**
Edward A. Ackerman, and George O. G. Lof.
Baltimore, Maryland, The Johns Hopkins Press, 1959. 710 p.

Descriptors: *Technology, *Water resources development, Administration, Political aspects, Water utilization, Water demand, Water supply, Water quality, Transportation, Irrigation, Water control, Groundwater, Sea water, Runoff, Flood control.
Identifiers: Public administration, Geographical aspects, Water quantity, Recycling, Administrative organization.

This volume is an exploratory study with the objectives of: (1) providing a review of the past technical changes important in water development, and the construction of a meaningful classification of such technical events; (2) an appraisal of the socially and economically relevant technical subjects suitable for more detailed study; and (3) an appraisal of the manner of studying the relation between technology and administration of water development in the United States. The greater part of the study treats the proven technology which has influenced water development in the past or which still is effective in shaping its course. However, the study also treats the newer technology. This may have only modest immediate significance, but its potential importance is large. What this emerging technology may mean in terms of the evolving technological structure of water development in the United States is considered in the last chapter of this study. (Loeb-Rutgers)
W70-03008

**NATURAL RESOURCES FOR U S GROWTH,**
Resources for the Future, Inc., Washington, D.C.
Hans H. Landsberg.
Baltimore, Maryland, The Johns Hopkins Press, 1964. 260 p.

Descriptors: *Natural resources, *Water supply, Water uses, Withdrawal, Income, Water demand, Irrigation, Technology, Water quality, Dissolved oxygen, Regional analysis, Agriculture, Gross National Product, Construction, Transportation, Demand.
Identifiers: *Future requirements, *Resource adequacy, On-site uses.

This is an examination of the adequacy of natural resources in the United States over the rest of the century. The broad prospects for the economy as a whole are discussed with projections made of GNP, various types of spending, and the expected advances in technology. Future requirements for living are considered as well as what they appear to mean in terms of needs for the various natural resources and their products. The availability of resources to meet these projected requirements is considered. Although much of the discussion is applicable to water resources there is a substantial section devoted specifically to water. The unique characteristics of water use and problems are considered along with demand indicators, depletion for specific withdrawal and nonwithdrawal uses, the requirements for water quality, as well as the characteristics and adequacy of future water supply. In the last section some of the chief policy issues suggested are reviewed. (Murphy-Rutgers)
W70-03011

**THE SOCIAL SCIENCES AND AMERICAN CIVILIZATION,**
Bruce Watson, and William Tarr.
New York, John Wiley and Sons, Inc, 1964. 584 p.

Descriptors: *Institutions, Political aspects, Economics, Community development, Schools, Military aspects, Gross national product, Income, Resource allocation, Management.
Identifiers: *Social sciences, *American civilization, *Socialization, *Economic institutions, *Political institutions, Personality, Human group, Urban society, Traditional society family, Church, Capitalism, Economic roles, Democracy, Classical view, Income distribution, Economic revisionist, Entrepreneur, Consumption.

The point of view found in this book is based on the interrelatedness of knowledge in the social sciences. The authors have selected some of the major themes and concepts from the behavioral sciences and have applied these to various trends and institutions of American civilization. The study of American trends and institutions has been placed in a historical context as an aid to the application of concepts. For example, in the study of economic institutions the historical development of capitalism as a form of social organization and as an ideology are discussed before the strictly behavioral subject matter. The concepts introduced throughout the book are illustrated and elaborated by the frequent inclusion of the works of other authors. Part one of the book is devoted to four tools of analysis which form the analytic basis of the list. Part two deals with the nature of the human community; Part Three and Four with the socialization process; Part Five with the economic institution; Part Six with political institutions, and Part Seven with certain unsolved problems in American civilization. This volume provides the water manager and water researcher with a broad picture of the institutions within which social decisions are made as well as specifically reviewing some of the trends in economics and management. (Loeb-Rutgers)
W70-03012

**PUBLIC INVESTMENT CRITERIA,**
Massachusetts Inst. of Tech., Cambridge.
Stephen A. Marglin.
Cambridge, Massachusetts, The MIT Press, 1967. 103 p.

Descriptors: *Cost-benefit analysis, *Investment, *Government, Economics, Capital, Discount rate, Economic efficiency, Pricing, Costs, Regional analysis, Indirect benefits, Budgeting, Dynamics, Economic evaluation.
Identifiers: *Public investment, *Intertemporal criteria, *Investment objectives, Redistribution, Willingness-to-pay, Merit-want, Investment timing.

This book explores some of the theoretical problems of subjecting public investment decisions to cost-benefit analysis. A short history of cost-benefit analysis is presented, followed by an analysis of the objectives relevant to investment planning, along with the methods of specifying their relative importance. The different types of possible benefits and their relation to objectives as well as costs are discussed. The fact that the meaning of benefits and costs varies from objective to objective is stressed. The choice of an intertemporal criterion receives significant space and the author proposes weights be imposed on each contribution to each objective in each time period. The role of uncertainty is evaluated as well as the effects of secondary benefits and private alternatives to public investment. A brief discussion of the applicable principles of pricing concludes the book. Both the large role of government and the increased use of cost-benefit analysis in water resources make this book useful to the water researcher. (Murphy-Rutgers)
W70-03016

**THE BENEFITS FROM WATERSHED DEVELOPMENT,**
Soil Conservation Service, Washington, D.C.; Tennessee Valley Authority, Knoxville; and North Carolina State Univ., Raleigh.
Erwin C. Ford, Elco L. Greenshields, and Fletcher E. Riggs.
In: Economics of Watershed Planning, p 27-41, Iowa State University Press, Ames, 1961. 15 p, 1 fig, 2 tab.

Descriptors: *Benefits, Geographical regions, Planning, Water management, Municipal water, Industrial water, Drainage, Irrigation, Recreation, Wildlife, Competition.
Identifiers: Watershed development, Complementarity, Public Law 566, Watershed projects, Wildlife benefits, Flood prevention.

This paper attempts to give perspective to benefit issues confronting planners. It concentrates on physical and economic factors conducive to different kinds of benefits. It also considers whether, in securing one type of benefit, the expense of securing other benefits is affected or, in other words, whether complementarity or competitiveness exists between benefits. This chapter is based partly on benefit estimates taken from Public Law 566 watershed work-plans. For classifying the projects, the country was divided into 13 regions. The regional breakdown conforms to physiographic and economic characteristics. It has been designed to contain the minimum number of regions necessary for reasonable homogeneous groupings of projects. The first part of the chapter describes the benefits with which the small watershed program is concerned under Public Law 566 and related laws. Results from project plans through time and by regions are presented. The second part concerns some hypotheses to explain geographic distribution of benefits. Finally, issues surrounding benefits in the planning process are considered. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03018

**APPLYING ECONOMIC PRINCIPLES IN WATERSHED PLANNING,**
Department of Agriculture, Washington, D.C.
George A. Pavelis.
In: Economics of Watershed Planning, p 151-164, Iowa State University Press, Ames, 1961. 14 p, 2 fig, 3 tab.

Descriptors: Economics, *Welfare resource allocation, Cost-benefit analysis, Benefits, Costs, Linear programming, *Watersheds.
Identifiers: *Watershed planning, *Nepper watershed.

Watershed development can be viewed as a welfare-oriented economic reorganization in which welfare may be increased by two means: (1) a more efficient allocation of resources currently available to the reorganizing participants, and (2) an efficient allocation of additional resources made available for development purposes. According to modern welfare theory, welfare in the aggregate can be increased only to the extent the welfare of any individual participant would not be decreased by reason of watershed programs being carried out. The crux of watershed planning may be viewed as finding the adjustments in resource use required to increase welfare as much as possible. The resource adjustments are reflected by changed systems of land use or by the installation of water control structures. These are referred to, respectively, as land treatment measures and structural measures. The planning framework used in the Nepper watershed is presented which shows how to combine measures so as to achieve maximum net benefits, subject to any specified restriction. Linear programming was illustrated as a useful supplement to conventional benefit-cost analysis for solving comprehensive watershed planning problems on a multipurpose basis. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03019

**ORGANIZATION FOR WATERSHED PLANNING IN THE PUBLIC INTEREST,**
Tennessee Valley Authority, Knoxville.
Robert E. Lowry.
In: Economics of Watershed Planning, p 246-259, Iowa State University Press, Ames, 1961. 14 p.

Descriptors: Water resources, Flood control, *Water management, Economics, Planning, Cost sharing, *River basin development.
Identifiers: *Watershed planning, *Public interest.

Three issues of watershed planning are considered. The first states that the organization of the national watershed program according to local units, with the transient characteristics inherent in the project approach, tends to remove watershed development

from the normal channels through which most public services are administered and financed. The result is that this activity is an appendage to public policy rather than an integral part of it. The second issue raised is that separate economic justification of watershed projects impairs opportunity to view in wider perspective the contribution watershed planning can make to water management and economic development for nation and region. A third concern is what might be done organizationally to establish watershed planning and development more firmly as a national program within a framework of federal and state policy. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03020

**MULTIPLE PURPOSE LAND AND WATER DISTRICTS IN ONTARIO,**
University of Western Ontario, London.
E. G. Pleva.
In: Comparisons in Resource Management, Baltimore, Johns Hoptkins Press, p 189-207, 1961. 19 p, 2 map.

Descriptors: *Watersheds, *Conservation, *Research and development, Water supply, Recreation, Flood control, Ponds, Drainage basin, Lakes, Rivers, Dams, Reservoirs, Streams, Fish, Managment.
Identifiers: *Ontario, *Conservation Authorities Act, Hydrometric records, Meteorogical records, Municipalities.

This article deals with the distinctive multiple purpose land and water resources district of Ontario as a device for carrying out a coherent set of programs drawing on several governmental departments. The operation of these districts dates from the 1964 Conservation Authorities Act, which permits local government to organize as an authority for purposes of flood control, fish and wildlife management, and any other scheme related to the conservation of natural resources within a drainage basin. In the case of water, hydrometric and meteorological records of the watershed are studied, as are flood records, reservoirs, lakes, ponds, and dams. After such study, assistance is requested by the Authority, from the government. Such aid may be economic or technical, but must be requested as a control measure on the Authority. The public is consulted, and a timetable of projects is presented, allowing for long-range modification as research and practice develop the plan. (See Vol 2, No 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03022

**LAND AND WATER DEVELOPMENT IN SOUTHERN FRANCE,**
National Co. for the Management of the Lower Rhone and Languedoc Region.
For primary bibliographic entry see Field 03F.
W70-03023

**ORGANIZATIONAL ADAPTATION TO CHANGE IN PUBLIC OBJECTIVES,**
Colorado State Univ., Fort Colling. Dept. of Political Science.
D. Hill, P. O. Foss, and R. L. Meek.
Partial Completion Report, Colorado Natural Resources Center, June 30, 1969. 40 p, 24 tab, 1 fig. OWRR Project A-005-COLO.

Descriptors: *Organization adaptation, *Public objectives, *Water planning.

A case study of the Poudre River system in Colorado shows that generally, the organization for water distribution has maintained consistency of value perspective but have adopted their organizations forms, patterns of behavior, and communication linkages, to the requirements of changing system parameters. The development of the Poudre River Water Users Association is illustrative of a pattern of institutional innovation and cooperative activity by the organizations to maintain effective influence in a changing environment. There is an indication of intensification of demands by local water officials for a greater voice in the system. Given the patterns of perception by all actors in the system of the awareness, interest, and understanding of water matters by local water officials, it seems clear that the system will increasingly adapt to the values and objectives represented by these officials.
W70-03024

**A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,**
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03035

**STATE ORGANIZATIONS FOR WATER RESOURCES PLANNING,**
Daniel H. Hoggan.
Am Water Wks Ass'n J, vol 61, no 12, p 667-674, Dec 1969. 8 p, 1 ref.

Descriptors: *Water resources development, *Planning, *State governments, *Administrative agencies, River basin development, Federal project policy, Federal government, Administration, Conservation, Interstate commissions, Political aspects, Universities, Inter-agency cooperation, Wildlife conservation, Parks, Recreation, Financing, Legislation, California, New York, Minnesota, Texas, Utah.
Identifiers: *United States Water Resources Council.

A study was made of five state water planning agencies to determine the most efficient organizational structure for water resources planning and administration. This study analyzed the California Department of Water Resources, Minnesota State Planning Agency, New York Resources Water Commission, Texas Water Development Board, and the Utah Division of Water Resources. The study resulted in several recommendations as to the organization of a model water resources agency. Water resources development can best be managed by one state executive agency under a single chief executive. Related conservation areas such as wildlife, parks, and recreation should be combined under the same agency as water resources planning. The agency staff should be made up of specialists and be adequately equipped and financed. Special efforts should be made to coordinate executive and legislative programs. The expertise and research facilities of universities should be utilized. Requests of special interest groups should be considered in defining policy. The state should coordinate its water planning with the federal agencies, other states' agencies, and local organizations. Further recommendations are made as to the ideal structure of the agency staff. (Dearing-Fla)
W70-03039

**COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESH WATER SUPPLY FROM A CONVENTIONAL SOURCE,**
Texas Water Development Board, Austin. Planning Hydrology and Special Studies Div.
For primary bibliographic entry see Field 06C.
W70-03082

**ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,**
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
Myron B. Fiering.
ASCE Proceedings, Journal of Sanitary Engineering Division, Vol 95, No SA4, Paper 6720, p 683-698, Aug 1969. 16 p, 8 fig, 6 tab, 6 ref.

Descriptors: *Data collections, *Sampling, *Statistical methods, *Cost-benefit analysis, Hydrograph analysis, Duration curves, Streamflow forecasting, Stochastic processes, Water yield, Water storage, Reservoir operation, Reservoir design, Water management (Applied).
Identifiers: *Extreme data analysis.

Hydrologic and sanitary engineers collect flow data with religious zeal, and practically no project is designed without a plaintive appeal for more data. Data collection agencies are concerned about the propriety, validity and utility of collecting more data everywhere, and have mounted systematic analyses of the cost and benefit associated with more observations. Techniques for evaluating the economic significance of extreme data are suggested; general guidelines, for selecting among competing design models which purport to be adequate to the task, are offered. Simulation and streamflow synthesis are used to derive performance indices from which conclusions can be reached in particular cases. The study does not make specific design recommendations. (Knapp-USGS)
W70-03091

**WATER, EARTH AND MAN: 2. WORLD WATER INVENTORY AND CONTROL,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-03096

**THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION.**
Western Agricultural Economics Research Council, Denver, Colo.

Delworth B. Gardner, and Robert A. Young, Cochairmen. Conference Proceedings, Committee on the Economics of Water Resources Development, Denver, Colo, Dec 17-18, 1968. 106 p, 23 tab, 2 fig, 9 articles.

Descriptors: *Discount rate, Evaluation.
Identifiers: *Public investment, *Social discount rate.

Discounting makes revenues and costs occuring in different planning intervals comparable in time. The explicit discount rate chosen will affect investment decisions in public and private resources. The publication is divided into two parts: The views from the Academy, and a panel discussion giving the views from the Federal Government. Four articles comprise the first part: On measuring the social opportunity cost of public funds; measuring the opportunity cost of private investment; the opportunity cost of displaced private spending and the social discount rate; and the discount rate in public investment evaluation. The second part is comprised of five statements by members of the Federal Government. (See also W70-03155 thru W70-03158). (Grossman-Rutgers)
W70-03154

**ON MEASURING THE SOCIAL OPPORTUNITY COST OF PUBLIC FUNDS,**
Chicago Univ., Ill.
Arnold C. Harberger.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 1-24, Dec 17-18, 1968. 24 p, 1 fig, 1 append, 4 ref.

Descriptors: *Discount rate, Interest rate, Time investment.
Identifiers: *Social discount rate, Opportunity costs.

In the basic model it is assumed that the social rate of time preference refers to an appropriately weighted average of the different marginal rates of time preference applicable to the individuals who compose society. A simple analytical framework which is sufficiently general to yield the market rate of interest, the private-sector marginal productivity of capital, and the social rate of time

preference as the appropriate rate of discount under special circumstances, is presented. The solution that emerges in the general case is equal to a weighted average of the last two or to the market interest rate adjusted for distortions in the capital market. An alternative formulation of the social opportunity cost of capital takes into account the external effects of Government borrowing. The implications of the analysis are discussed. (See W70-03154). (Grossman-Rutgers)
W70-03155

**MEASURING THE OPPPRTUNITY COST OF PRIVATE INVESTMENT,**
Institute for Defense Analyses, Arlington, Va.
J. A. Stockfisch.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 25-49, Dec 17-18, 1968. 25 p, 14 tab, 1 append, 9 ref.

Descriptors: *Discount rate, Interest rate, Investment, Inflation (Economic).
Identifiers: *Social discount rate, Opportunity costs.

The discount rate used to evaluate government programs should reflect the opportunity cost of private investment. The appropriate methodology to measure the opportunity cost of private investment is developed. What is needed is a measure of the marginal efficiency of private investment. Part I of the paper shows why yields of claims are inadequate measures of the opportunity cost of capital. A methodology is developed to measure the rate of return which utilizes the asset approach. Part II of the paper actually measures the rate of return. Part III of the paper presents a note on adjusting an empirically estimated or revealed rate of return for inflation. (See W70-03154). (Grossman-Rutgers)
W70-03156

**THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,**
Joint Committee on Economics (U.S. Congress).
Robert H. Haveman.
Conf Proc, Comm on the Econ of the Water Resources Develop, Denver, Colo, p 51-69, Dec 17-18, 1968. 19 p, 6 tab, 13 ref.

Descriptors: *Discount rate, *Investment, Interest rate.
Identifiers: *Social discount rate, *Opportunity costs.

This paper outlines the major contending arguments in the debate on the social discount rate concept and its empirical estimation: The social time preference position; the opportunity cost position, and the preferred opportunity cost position. Finally, an empirical estimate is made of the opportunity cost of displaced private spending using the empirical framework implicit in the preferred social interest position. This calculation is a grand-weighted-average of the opportunity costs of marginal public spending displaced by taxes. This position is the opportunity cost of public investments financed by the personal income tax. (See W70-03154). (Grossman-Rutgers)
W70-03157

**THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION,**
Howard Univ., Washington, D.C.
Stephen A. Marglin.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 71-82, Dec 17-18, 1968. 12 p, 16 ref.

Descriptors: *Discount rate, Interest rate, Investment, Competition.
Identifiers: *Social discount rate, Opportunity costs.

The case of perfect competition and Pareto optimality is examined. Such conditions lead to a market rate of interest is equal to the amount by which both the marginal rate of substitution of future for present consumption and the marginal rate of transformation between future and present consumption exceed unity. The following difficulties in the the theoretical identification of competitive equalibrium are examined: The open-endedness of the future, uncertainty, externalities (including public goods), increasing returns, risk-aversion, and income distribution. A discussion of the social rate of discount based on capital productivity (marginal rate of transformation) follows; last is a discussion of the social rate of discount based on the marginal rates of substitution. (See W70-03154). (Grossman-Rutgers)
W70-03158

**A MULTIAGENCY DECISION MODEL FRAMEWORK FOR BENEFIT-COST ANALYSIS,**
Waterloo Univ. (Ontario). Dept. of Management Sciences.
Donald J. Clough.
Canadian Oper Res Soc, Vol 7, No 3, p 193-203, Nov 1969. 11 p, 1 fig, 35 ref.

Descriptors: *Decision making, *Cost-benefit analysis, *Public benefits, *Water resource development, *Planning, Optimization, Joint cost, Professional societies, Political constraints.

The porblems of benefit-cost analysis of public works projects that arise when many different agencies enter into the decision-making process were discussed. Water resource planning projects in the Province of Ontario were discussed as examples in which government departments, political representatives, professional associations private groups, and public organizations directly or indirectly specified objectives and constraints. It was indicated that in principle each agency could have its own optimality criterion. However in the end, a decision to select a unique plan for implementation was usually based on political bargaining. If it turned out that all agencies selected the same optimal plan, the political problems were reduced. The bargaining processes in reaching agreement on a single plan on the basis of joint criterion function were not well understood or modelled. (Thiuri-Cornell)
W70-03163

**TIME CAPACITY EXPANSION OF WASTE TREATMENT SYSTEMS,**
Pennsylvania State Univ., University Park; and Stanford Univ., Calif.
For primary bibliographic entry see Field 05D.
W70-03167

**CONTROL OF WATER QUALITY IN A COMPLEX NATURAL SYSTEM,**
Clemson Univ., S.C. Dept. of Environmental Systems Engineering; and Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 05B.
W70-03170

**OHIO WATER COMMISSION.**

Ohio Rev Code Ann secs 1525.01 thru 1525.04 (Page 1964), as amended, (Supp 1970), secs 1525.05, 1525.06, 1525.11 thru 1525.13 (Page Supp 1970).

Descriptors: *Ohio, *Water resources, *Water supply, *Flood control, Legislation, Legal aspects, Surface waters, Subsurface waters, Aquifers, Water utilization, Watersheds (Basins), Beneficial use, Hydroelectric power, Regulation, Administrative agencies, Water conservation, Water management (Applied), Data collections, Watercourses (Legal), Planning, Financing, Water quality, Water pollution, Bodies of water.

'Water resources' means all surface waters and all subsurface waters which are available or may be made available to agricultural, industrial, public, commercial, recreational and domestic users. 'Beneficial use' means a use of water that is reasonable and consistent with the public interest in the proper utilization of water resources. 'Water management' means planning, financing, or operating water improvements and programs. A Water Commission is created within the Department of Natural Resources to carry out the purposes of this section. In order to coordinate the water programs of the state, to develop water supply and flood control, and to obtain the most beneficial use of water resources, the Commission is authorized to: (1) recommend water development plans; (2) recommend water policy and legislation; (3) encourage the development of water resources; and (4) acquire and disperse hydrologic data. The factors which the Commission will consider prior to recommending loans for water management purposes are enumerated. The Commission will certify proposed water quality standards. The Water and Sewer Rotary Commission is created to handle applications for state funds to meet the cost of extending water and sewer lines for industrial purposes. (Keith-Florida)
W70-03212

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**OPPORTUNITY COST CALCULATIONS IN COST-BENEFIT ANALYSIS,**
Nuffield Coll., Oxford (England).
Martin S. Feldstein.
Public Finance, Vol XIX, No 2, p 117-139, 1964. 23 p.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Investment, Financing, Value, Interest rate, Benefits, Capital, Debt, Taxes, Costs, Optimization, Budgeting.
Identifiers: *Public investment, *Opportunity costs, *S.O.C., *S.T.P., Rate of return, Social productivity, Target rates, Payback.

The social opportunity cost (SOC) of a public investment project is the value to society of the best alternative use to which the resources could have been put the SOC rates that have been suggested by others as measures of the opportunity cost of funds transferred from the private sector are inappropriate. An SOC rate can only be used as a measure of the social productivity of a private investment. The author shows that the SOC of funds transferred from other agency projects because of capital rationing cannot be evaluated by previously proposed methods. He also demonstrates that evaluating public investment projects in a mixed economy requires separate treatment of social time preference (STP) and SOC rates and that previously advocated methods for combining STP and SOC are inappropriate. Both the extent of government investment in water resource development and the wide-spread use of cost-benefit analysis, make this article useful to the water researcher. (Murphy-Rutgers)
W70-02985

**SECOND-BEST RULES FOR PUBLIC ENTERPRISE PRICING,**
Queen Mary Coll., London (England).
R. Rees.
Economica, Vol 35, No 139, p 260-273, Aug 1968. 14 p, 11 ref.

Descriptors: *Pricing, *Marginal costs, *Welfare, Prices, Efficiencies, Constraints, Monopoly, Taxes.
Identifiers: *Second-best, *Public enterprise pricing, Marginal cost pricing, Public sector, Private sector, Subsidies.

The case for marginal cost pricing by a public enterprise requires that prices equal marginal costs in the rest of the economy and it assumes that any resulting profit or loss is acceptable. In fact, the

requirement is not met and the assumption is invalid. There is often a close relationship between a public enterprise and private industries which do not sell at marginal cost. The basic principle is that public enterprise prices should be set so as to maximize welfare and achieve allocative efficiency. Any pricing rule which purports to be optimal in this sense and which is seriously proposed as a practicable basis for pricing must take into account the constraints which are likely to exist. These will in general involve departures from the conditions under which marginal cost pricing rules are derived and so we are in the domain of the 'second best.' Using some recent developments in the theory of the second best, the author attempts to examine the implications of the welfare maximization criterion when financial targets in the public sector and price/marginal-cost divergences in the private sector are taken into account. The constraint of the availability of information on which to calculate prices, and the costs of this information are ignored. Pricing policies for water supply involve questions of second-best solutions and this article may be relevant to the theoretical pricing problems of water. (Loeb-Rutgers)
W70-02988

**TWO PROPOSITIONS ON THE OPTIMUM LEVEL OF PRODUCING COLLECTIVE GOODS,**
Washington Univ., Seattle.
Yoram Barzel.
Public Choice, Vol 6, p 31-37, Spring 1969. 7 p, 3 fig, 1 append.

Descriptors: Demand, Costs, Governments, Economies of scale, Return.
Identifiers: *Optimality, *Collective goods, Homogeneous groups, Interpersonal comparisons, Subgrouping.

This paper discusses the problem of what is the optimal level of government for the production of collectively produced goods. Such a question is applicable to the water area in sectors such as water purification, anti-pollution measures and water supply. The paper is concerned with situations where economies of scale are not exhausted and where it is thus more costly to supply the service on a smaller scale, and with situations where segregation of consumers into homogeneous groups is not easy. The discussion of the first problem is basically at the individual level, and no interpersonal comparisons are necessary. The discussion of the second does involve such comparisons. (Loeb-Rutgers)
W70-02996

**POSITIVISTIC MEASURES OF AGGREGATE SUPPLY ELASTICITIES: SOME NEW APPROACHES,**
Oklahoma State Univ., Stillwater.
Luther G. Tweeten, and C. Leroy Quance.
AER, Vol 59, No 2, p 175-188, May 1969. 14 p, 4 tab, 14 ref, 3 disc.

Descriptors: *Elasticity of supply, Prices, Regression analysis.
Identifiers: *Positivistic measures, *Aggregate supply elasticities, Farm output, Direct least squares, Aggregate supply function.

Supply elasticities indicate the speed and magnitude of output adjustments in response to changes in product price. The authors are concerned in this paper basically with the elasticity parameter for aggregate farm output. Questions which the authors attempt to answer in this paper include: What is the magnitude of the elasticity of U S farm output with respect to price in the long and short run. Is the elasticity increasing over time as the ratio of purchased to nonpurchased inputs increase. Are farmers less responsive to price decreases than to price increases as fixed asset theory implies. Three positivistic approaches are used to estimate the aggregate supply elasticity. The first is a direct least squares estimate of the aggregate supply function. Two additional disaggregate approaches which circumvent at least some problems of intercorrelation are also used to estimate the supply elasticity. These quantitative approaches may prove to be useful estimating the elasticities of supply in the water area as well. (Loeb-Rutgers)
W70-02997

**BUDGET CONSTRAINTS: REDUCING THE ADMINISTRATOR'S FREEDOM,**
Minnesota Univ., Minneapolis.
J. E. Jernberg.
Public Management Vol 51, No 8, p 10-13, Aug 1969. 4 p.

Descriptors: *Budgeting, *Decision-making, *Environment, *Technology, Taxes, Industries, Economics, Revenue, Education, Management, Community development.
Identifiers: *Budget constraints, *Community resources, Balanced budget, Appropriations, Expenditure accounting, Intergovernmental relationships.

The article considers the constraints on a budget-maker, past the normal establishment of categories for expenditure accounting control. Internal environmental constraints of the city's social and economic structure and characteristics are considered. Each community's characteristics determine its taxable resources and consequently affect managerial ability to fulfill community needs. Managerial willingness to fill these needs is another constraint, as is the decision-making of other governmental units. Reliance upon external revenue sources and related fiscal interdependence among levels of government is another important element that must be faced by the budget-maker, along with the obvious additional environmental factors. Since all of the problems cited are those faced in urban water resource planning, this article is of special interest to decision-makers in that field. (Murphy-Rutgers)
W70-03000

**A COMPARISON OF DECISION CRITERIA FOR CAPITAL INVESTMENT DECISIONS,**
State Univ. of New York, Buffalo.
C. C. Pegels.
Engineering Economist Vol 13, No 4, p 211-220, Summer 1968. 10 p, 3 tab, 6 ref, 1 append.

Descriptors: *Investment, *Capital, *Computers, *Input/output analysis, *Simulation analysis, Management, Planning, Time, Prices, Costs, Decision-making.
Identifiers: Output criteria, Cash flow, Probability, Common stocks, Rate of return, Decision criteria.

This article discusses the making of capital investment decisions. These decisions are based on one of several criteria. These are output criteria to aid selection from two or more investment proposals. This article reviews seven output criteria and compares them by simulating two hypothetical investment proposals on a digital computer. Although the computer results are not entirely conclusive as far as the investment decision is concerned, the simulation experiment demonstrates that investment proposals should be evaluated on the basis of several decision criteria rather than one preselected decision criteria. The method given is designed to facilitate and improve the quality of decision-making in capital investment problems. Since such decision-making is important in water resource projects, decision-makers in this field will find this article useful. (Murphy-Rutgers)
W70-03002

**ECONOMICS OF LEAK SURVEYS,**
Pitometer Associates, Pittsburgh, Pa.
Homer E. Beckwith.
American Water Works Association Journal, Vol 56, No 5, p 275-278, May 1964.

Descriptors: *Costs, *Leakage, *Economic efficiency, Statistics, Water transportation, Construction, Water treatment, Wells, Water rates, Water storage.
Identifiers: *Pumped water supplies, *Gravity water supplies, Capacity.

Water is considered free and the charges made are for the services of treatment and delivery. Due to the low costs, inefficiency is likely to be tolerated. However, the aggregate costs of leaks in water transportation are likely to be sizable for the system as a whole. The distance which many cities must go for water, the increasing scarcity and the cost of treatment make this inefficiency intolerable. The author proposes increasing the metered rates as the most economically efficient way of obtaining additional water. The patented savings available in correcting leaks in both gravity supplies and pumped supplies is evaluated with the conclusion that the situation demands immediate correction. (Murphy-Rutgers)
W70-03006

**COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESH WATER SUPPLY FROM A CONVENTIONAL SOURCE,**
Texas Water Development Board, Austin. Planning Hydrology and Special Studies Div.
Donald E. Morris.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 24, 1969. 12 p, 5 fig.

Descriptors: *Cost analysis, *Desalination processes, *Water supply, *Texas, Saline water, Desalination plants, Brine disposal, Wells, Pipelines, Pumping plants, Fresh water, Water quality, Water chemistry, Economics.
Identifiers: Fresh water costs, Desalted water costs.

The cost of desalted water is generally higher than the cost of water from an alternative supply. The elements included in calculating the cost for desalting in Texas are: (1) well fields for saline feedwater supply; (2) intake system and pumping station; (3) pipelines; (4) pretreatment for saline water; (5) the desalting plant; and (6) brine disposal. The following elements were considered for calculating the cost of a conventional water supply: (1) raw water cost; (2) well field or intake system; (3) pipeline and required pumping stations; and (4) a conventional water treatment plant. Chemical water quality, secondary benefits, and project life are considered for final economic justification of a desalt project. Desalting is recommended as a practical interim solution for water supply problems in Texas. (Carstea-USGS)
W70-03082

**A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART ONE,**
Iowa Univ., Iowa City.
N. William Hines.
Natural Resources Journal, Vol 7, No 4, p 499-554, Oct 1967. 5 tab, abt 140 ref.

Descriptors: *Iowa, Riparian rights, Administrative agencies, Beneficial use, Priorities, Administrative decisions, *Water permits.
Identifiers: *Permit system, *Iowa Water Permit Statute.

The article describes the Iowa permit system after its first ten years of existence. Part One includes Section I and Topic A of Section II. Section I examines riparian law in Iowa, reviews events leading up to enactment of the Iowa Water Permit Statute, examines the statute in detail, and compares present Iowa law to that of other jurisdictions. The statute has two main faults: it does not define any regulatory policy; and ideas drawn from various sources were never made consistent; some provisions actually contradict others. Similarities to western water law include employment of an allocation agency and utilization of the broad standard

of 'beneficial use.' Central difference are that Iowa accords no permanence of right and establishes no priority. Section II highlights issues faced in administering the permit system and describes in detail the endeavors of the Water Commission to resolve them. Topic A focuses on the issue of interpreting the scope of regulatory power. Decisions regarding vested rights, types of use to be regulated, amount of regulation to impose and the nature of rights granted by a permit are discussed. (See W70-03144). (Gossen-Chicago)
W70-03143

**A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART TWO,**
Iowa Univ., Iowa City.
N. William Hines.
Natural Resources Journal, Vol 8, No 1, p 23-71, Jan 1968. 9 tab, 91 ref.

Descriptors: *Iowa, Administrative decisions, *Water permits, Priorities.
Identifiers: *Permit system, Processing applications, Permit transfer, Permit renewal, Permit modification, Permit termination, Permit suspension, Constitutionality.

The article describes the Iowa permit system after its first ten years of existence. Part Two includes: Topics B through E of Section II; Section III; and Conclusions. Section II highlights issues faced in administering the permit system and describes in detail the endeavors of the Water Commissioner to resolve them. Topic B describes the procedure for processing original applications. The application form, pre-hearing investigation, hearings, final determination, and appeal are discussed. Topic C focuses on the transfer of permits, D on renewal and modification, and E on termination and suspension. Section III reviews possible constitutional principles on which the Iowa Water Act might be challenged as deficient; substantive due process; procedural due process; and delegation of powers. The section on conclusions emphasizes the issue of priorities of use for times of scarcity. Iowa's policy of granting a permit for every beneficial use may be justified at present, but will require re-examination as demands increase. It is recommended that research be undertaken now to create standards for distinguishing among beneficial uses. (See W70-03143). (Gossen-Chicago)
W70-03144

**RATES, REVENUES AND REALISM,**
Coffin and Richardson, Inc., Boston, Mass.
John C. Adams, Jr.
Journal of the New England Water Works Association, Vol 83, No 3, p 191-209, Sept 1969. 19 p, 6 tab.

Descriptors: *Water rates, Income, Public utilities.
Identifiers: *Two-part rate, New England, Service charge plus a commodity charge.

The doctrine of water rates set by public and privately-owned water utilities is the doctrine of fair and equitable rates. This doctrine means rates which avoid undue or unjust discrimination among the various classes of customers. The water system must be capable of producing, transmitting, and distributing the quantity of water desired by each customer at any given time. To be fair and equitable, the utility's rates and charges should be designed to reflect the savings inherent in the uniform use of water at higher load factors and conversely to reflect the higher costs inherent in low factor customers. Utilization of a two part rate consisting of a service charge plus a commodity charge is recommended. Histories of water rates in New England and of two part rates are given. The allocation procedures of such a two part rate is explained. (Grossman-Rutgers)
W70-03153

**A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,**
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03C.
W70-03159

**WATER SUPPLY - SANITATION - DITCHES (FINANCING).**

Ohio Rev Code Ann secs 6101.62-6101.64 (Page 1953).

Descriptors: *Ohio, *Water rates, *Public utilities, *Financing, Water works, Public utility districts, Legislation, State governments, Regulation, Legal aspects, Assessments, Administrative agencies, Sewage disposal, Sewers, Liquid wastes, Local governments, Cities.

A public corporation may appropriate the unappropriated funds of the corporation's water department to pay the annual levies or assessments by a conservancy district organized for the purpose of water supply. Only a certain percentage of the funds may be appropriated, and the rates to be charged by the public corporation for the water supplied are set. To retire interest and bonds and thus reduce the amount to be collected through an annual levy, the board of directors of a conservancy district may raise the water rates chargeable to a public corporation or person within the district. Ceiling rates are set as are guidelines for imposing such rates over a period of years. Increased rates shall be paid from water-works funds. Revenue from the increased rates is solely for the retirement of bonds. To pay assessments for the collection of sewage and liquid wastes, the public corporation may appropriate funds from the sewer fund derived from sewer rentals. (Barnett-Florida)
W70-03207

**SANITARY DISTRICT BOARDS OF APPRAISERS.**
Ohio Rev Code Ann secs 6115.29 thru 6115.44 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Appraisals, *Project planning, *Cost-benefit analysis, Legislation, Legal aspects, Reservoirs, Right-of-way, Easements, Damages, Planning, Eminent domain, Costs, Estimated costs, Benefits, Estimated benefits, Sewage, Sewage disposal, Water supply, Construction, Judicial decisions, Taxes, Assessments, Cost analysis, Value, Sewage districts.
Identifiers: Hearings, Settlements procedure.

Every sanitary district will have a board of appraisers consisting of three appraisers appointed by the court and recommended by the board of directors of the district. The board will appraise all property to be acquired for the works of the district. The board will also appraise all benefits and damages accruing to all lands within or without the district because of the execution of the official plan of the district. The board will have the assistance of the attorney, engineer and other employees of the board of directors in carrying out its function. In making appraisals, the board will consider only the effect of the execution of the official plan. After the board files its report with the court, notice thereof will be published. After publication of notice, the court will conduct hearings on exceptions taken to the report. If the court, after such hearings, concludes that the cost of implementation of the official plan is less than the resulting benefits, it will approve the board report. If the court finds the cost of implementation will exceed benefits, the court may disorganize the district or order the board of directors to prepare new plans. (Keith-Florida)
W70-03209

## 6D. Water Demand

**MAJOR USES OF LAND AND WATER IN THE UNITED STATES WITH SPECIAL REFERENCE TO AGRICULTURE-SUMMARY FOR 1964,**
Agricultural Research Service, Washington, D.C.
Thomas H. Frey, Orville E. Krouse, and Clifford Dickason.
Report avail for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402. Department of Agriculture, Economic Research Service Report No 149, 1968. 74 p, 14 fig, 31 tab, 19 ref, append.

Descriptors: *Water supply, *Water utilization, *United States, Consumptive use, Irrigation water, Land resources, Land use, Surveys, Data collections.
Identifiers: U.S. Land and Water use.

The 48-State annual renewable supply of 30 inches of average precipitation is equivalent to about 4.50 billion acre-ft, or 402 billion gpd over an average year. About 70% of the precipitation is consumed in place to support forest, range, and other vegetation, including nonirrigated farmland. The balance is runoff or streamflow, supporting such nonwithdrawal uses as power generation, waste dilution, navigation, and recreation. About 304 million acre-feet of streamflow and ground water were withdrawn for all purposes in 1965. Roughly 30% was consumed in the sense of not being available for withdrawal again. Agricultural irrigation accounted for 41.4% of all withdrawals but, because of a high rate of consumptive use (60%), represented 82.7% of the total consumption or net depletion. This consumption occurred on about 37.8 million acres of irrigated farmland in 1965, of which 34.9 million acres were concentrated in the western mainland regions or States. The national rate of increase in irrigated farmland is 1.85%. (Knapp-USGS)
W70-02891

**RIVER MANAGEMENT.**

Peter C G Isaac, ed. Alabama, University of Alabama Press, 1967. 258 p.

Descriptors: *Water quality, Water demand, River regulation, Rivers, Measurement, Computers, Telemetry, Water pollution, River flow, Discharge, Floods, Biochemical oxygen demand, Groundwater, Economics.
Identifiers: *River management, *Water quantity, Hydrological data, Fisheries, River control, Economic model.

The demand for water in England and Wales has steadily risen. As such, there is a growing need to develop more effectively the resources of rivers. The work of river authorities has emphasized the importance of river management. In the past, the various demands on the rivers have been under the jurisdiction of various bodies with different aims. Drainage has competed with water supply, and both have competed with angling and recreation. Criteria must be developed for reconciling these conflicting demands and it seems likely that such criteria must be economic in nature. Before such criteria can be developed, however, a number of technical factors must be brought into a common focus. For example, no real progress can be made until it is recognized that river-water quality is no less important than river-water quantity. The underlying theme of the symposium, whose papers are contained in this volume, was the control of the quantity and quality of river water so that it may be used to best effect for all its multifarious purposes. (Loeb-Rutgers)
W70-03015

**LOS ANGELES CITY PROPER AND HARBOR MASTER PLAN FOR WATER SUPPLY,**
Los Angeles City Dept. of Water and Power, Calif. Water Engineering Design Div.

Duane L. Georgson, Donald A. Trestik, John L. Graham, Toshio Fujimura, and E. S. Manirelli.
Report, City of Los Angeles Department of Water and Power, June 1966. 52 p, 16 fig, 8 tab.

Descriptors: *Water demand, *Water consumption, *Water supply, *Water conveyance, Aqueducts, Water distribution, Construction, Planning, Population, Forecasting, Urbanization, Construction costs, Project planning.
Identifiers: *Los Angeles, *Los Angeles harbor area.

The report presents a schedule of construction of water supply and distribution facilities required by the city of Los Angeles prior to the year 1990 to meet anticipated needs by the city proper and harbor area. The recommended $17.2 million construction program include a new water reservoir, reservoir modifications, new regulating stations, new water mains and trunk lines, and cement lining of some trunk lines. The study was made to permit prudent planning prior to design and construction in preparation for meeting the water needs of a population increasing at a rate of approximately 50,000 persons annually. It is estimated that the projected city population of 4,485,000 persons will use water at an average rate of 1,285 cfs in 1990, based upon 185 gallons per capita/day. This would be an increase of 66 per cent over the average 1963 consumption rate. Water system operating problems and needs anticipated in 1969 are also presented in the report in order to plan for utilization of water supplied by the Second Los Angeles Aqueduct beginning in late 1968. Proposed 1969 system operations, improvements and necessary adjustments to present facilities are described. (Poertner-Chicago)
W70-03147

**EFFECTS OF NON-PRICE VARIABLES UPON PARTICIPATION IN WATER-ORIENTED OUTDOOR RECREATION: COMMENT,**
Wisconsin Univ., Madison.
E. J. L. David.
American Journal of Agricultural Economics, Vol 51, No 4, p 942-945, Nov 1969. 4 p, 2 tab, 5 ref.

Descriptors: *Recreation, *Regression analysis, Average income age, Education, Occupations.
Identifiers: *Dummy variables, *Explained variation, *Intercorrelation.

This paper is a comment on a previous article by Gillespie and Brewer, ('Effects of Nonprice Variables Upon Participation in Water-Oriented Outdoor Recreation', Amer Jour of Agr Econ, Vol 50, p 82-90, Feb 1968). Three criticisms of the original article are: (1) the amount of explained variance reported, (2) the dependent variable, and (3) the handling of the intercorrelations. The problem of intercorrelations may be dealt with through the use of dummy variables of groups of the intercorrelated variables. The use of 'number of visits' as a dependent variable leads to unequal weights between different observations. The use of a grouped or dummy dependent variable may help to correct this problem. Such a dependent variable will increase the amount of explained variance reported. The parameters were re-estimated using dummy dependent and independent variables. (Grossman-Rutgers)
W70-03160

**LEISURE MARKET STUDIES: I. Beach Users, II. Marina Development,**
Rutgers - The State Univ., New Brunswick, N.J. Urban Studies Center.
George Sternlieb, Robert W. Burchell, James W. Hughes, and Paul A. Woodell.
Urban Studies Center, Rutgers University, Feb 1969. 161 p, 8 exhibit, 172 tab, 1 append, 3 map.

Descriptors: *Beaches, *Marinas, On-site data collections, Surveys, Financing.
Identifiers: *Beach users, *Marina development, *New Jersey shore.

This report studied the uses of the New Jersey shore through the use of surveys and questionnaires. The beach user survey covered the following areas: Beach attendance, problems of development as seen by shore entrepreneurs, age of structures (facilities), race observations, means of transportation to the beach town, length of total stay, total number of individuals, accommodations, occupations of beach users, and possible improvements. In the section on marina development the report attempted to isolate the variables which make for marina expansion. It is recommended that the state should intervene and that more mechanics are needed. The report also discusses the historical development of marinas, the problem of marina development, the operation of marinas, and various aspects of public marinas. A large appendix of data on beach users and marinas is included. (Grossman-Rutgers)
W70-03161

**WATER TRANSPORT COSTS,**
Binnie and Partners, London (England); and King's Coll., London (England). Dept. of Civil Engineering.
N. Paine, and J. K. White.
J Instut Water Eng, Vol 23, No 7, p 435-448, Oct 1969. 14 p, 3 fig, 2 tab, 3 append.

Descriptors: *Water transfer, *Water demand, *Mathematical models, *Optimization, *Cost-benefit analysis, Design, Pumping plants, Pipelines, Discount rate, Digital computers, Water distribution (Applied).

A method was described for the outline design, at minimum present value of the costs, of a pumping scheme to meet a growing demand for water transport within a typical range of unit costs and discount rates. A cost function model was developed for the optimum transport system which consisted of pumping stations, pumps, motors, control gear and pipes to illustrate the formulation of the cost as a function of all parameters. A digital computer was utilized for evaluating the minimum value of the costs for a representative range of stage lengths and pipe diameters. The affects of varying the system data, the pipe diameter and stage length were discussed. The solution for a typical scheme was given as an example. Simply staging both the station and the plant every 10 years yields a near optimum solution. Non-optimum pipe stages can lead to significant increases up to 13 per cent in total cost. (Thiuri-Cornell)
W70-03172

**STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,**
Water Resources Engineers, Inc., Springfield, Va.; and Texas Water Development Board, Austin.
G. K. Young, and C. D. Puentes.
Water Resources Res, Vol 5, No 5, p 1110-1114, Oct 1969. 5 p, 2 fig, 5 ref.

Descriptors: *Reservoir Design, *Storage capacity, *Multiple-purpose reservoir, *Time series analysis, *Water demand, *Systems analysis, Irrigation water, Municipal water, Industrial water, Timing.
Identifiers: Sequent peak algorithm.

The sequent peak algorithm was extended to find volume requirements as a function of time. The objective of the study was to present and demonstrate a technique for finding storage requirements in a multireservoir system. The technique evolved from a design situation having demands (irrigation municipal and industrial) increasing over time. The need for storage was found and placed in time at that point which was the latest time the storage could be built into the system and still be completely effective in carrying water forward to satisfy future droughts, within a minimum cost water development plan. The multireservoir systems storage yield relationships were three-dimensional, having time as the additional variable: aggregated design drafts versus time and required systems storage versus time. The technique was useful in determining reservoir construction timing in multiple reservoir systems. The principal variable used in the algorithm characterized a reservoir storage history which was unbounded by volume limits. (Thiuri-Cornell)
W70-03175

**BENEFICIAL USE OF WATER IN A RIPARIAN JURISDICTION,**
G. Graham Waite.
Wis L Rev, Vol 1969, No 3, p 864-883, 1969. 19 p, 88 ref.

Descriptors: *Wisconsin, *Indiana, *Riparian rights, *Water allocation, Administration, Competing uses, Distribution, Legal aspects, Water contracts, Water demand, Water policy, Water resources development, Water utilization, Alteration of flow, Diversion, Legislation, Relative rights, Beneficial use, Preferences (Water rights), Appropriation, Consumptive use.

Recognition of water as a limited resource leads to demands for regulating its use. New water uses must be developed within traditional riparian doctrines. This is an examination of problems of riparianism and possible methods for their solution through the application of administrative techniques to recognized riparian concepts. The diversion of water away from riparian owners presents constitutional questions. Regulation of water rights must avoid arbitrary distinctions between landowners and land uses. In Wisconsin, where water is being beneficially used, the riparian owner's consent is required for diversion; administrative control is limited to surplus waters. Some power over water use is centralized in the Department of Resource Development. Broad construction of the statute creating the Department might authorize a water use permit system. Indiana authorizes state purchase of water for public use. Problems of riparian rights along original and diverted watercourses are discussed. Surplus waters are exempted from riparian rights. This raises a question of deprivation of property that the riparian owner might later have used. Problems of uses of diverted water are discussed. The author concludes that authority for state water management may be inferred from legislation in Wisconsin and Indiana. (Dye-Florida)
W70-03177

## 6E. Water Law and Institutions

**ENTRY UPON LAND TO PROTECT HIGHWAY FROM DAMAGE BY WATER.**
N J Stat Ann secs 27:7-41, 27:7-49, (1966).

Descriptors: *New Jersey, *Highways, *Docks, *Bank erosion, Berms, Embankments, Roadbanks, Flood damage, Damages, Erosion control, Erosion, Bank protection, Piers, Jetties, Transportation, Condemnation, Right of way, Legal aspects, Transportation, Administrative agencies.

When deemed necessary, the Highway Commissioner may enter lands adjacent to state highways to reconstruct banks and structures necessary to preserve the highway. Such entry is neither trespass nor a taking for public use. The Highway Department may acquire land and water rights in any county of the sixth class and construct thereon structures, piers, wharves, or docks for the landing of boats for the carrying of freights, vehicles, and passengers. (Dye-Florida)
W70-02859

**PROCEEDINGS TO ESTABLISH LANDINGS.**
Miss Code Ann sec 7624 (1956).

Descriptors: *Mississippi, *Mississippi River, *Condemnation, *Public rights, Administrative agencies, State governments, Legislation, Navigable rivers, Inlets (Waterways), Bays, Bayous, Legal aspects, Public benefits, Land use, Riparian land, Docks.

Identifiers: *Boat landing.

Any three or more freeholders residing in a county bordering on the Mississippi River or other navigable river, bayou, bay, or inlet may petition the Board of Supervisors of such county to designate and set aside a parcel of land outside any municipal limits as a boat landing and cotton-yard for public use. The petition must identify the owner of the land proposed to be taken. The Board then shall determine whether such a landing is required for public convenience. If deemed necessary, the Board is to permit demarcation of a boat-landing site at a point most convenient for public use. (Barnett-Florida)
W70-02871

**MISSISSIPPI WATER RIGHTS LAW,**
Jack W. Pepper.
Am Water Works Ass'n J, Vol 50, No 8, p 997-1001, Aug 1958. 5 p, 3 ref.

Descriptors: *Mississippi, *Riparian rights, *Water rights, *Prior appropriation, Competing uses, Domestic water, Flood control, Industrial water, Irrigation water, Legislation, Municipal water, Obstruction to flow, Reasonable use, Riparian land, Riparian waters, Water pollution, Water law, Soil conservation, Dams, Drainage.

Despite an annual rainfall of almost sixty inches, increased industrial and irrigation demands have created the possibility of water shortages in Mississippi. Legislation created the Mississippi Water Resources Policy Commission to study this problem. The first laws adopted in Mississippi were based upon the riparian doctrine. Under this doctrine, the owner of land abutting a watercourse was entitled to use the water therein, undiminished in quantity and unimpaired in quality. The main fault with this doctrine is that it discouraged the full utilization of water resources. Even though modern courts adopted the principle of limiting riparian owners to reasonable use, non-riparians still had no right to the use of water from a watercourse. The Mississippi Water Rights Act of 1956 adopted the principle of water appropriation. This legislation, while declaring all natural surface water to be public water and subject to appropriation, recognizes numerous rights of riparian owners. The details of this legislation are outlined. Certain priorities are involved to insure an orderly development of surface waters. Other methods used to increase the available supply of water include prevention of waste and pollution and soil conservation practices to increase the groundwater recharge. (Schram-Florida)
W70-02897

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL,**
For primary bibliographic entry see Field 04B.
W70-02898

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (NON-STATUTORY RULES),**
For primary bibliographic entry see Field 04A.
W70-02899

**THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (STATUTORY MATERIALS),**
For primary bibliographic entry see Field 04B.
W70-02900

**RECREATIONAL USE OF ENTIRE PRIVATE LAKE BY RIPARIAN PARTIAL BED OWNER.**
Kan L Rev, Vol 9, No 1, p 91-94, Oct 1960. 4 p.

Descriptors: *Kansas, *Riparian rights, *Lake beds, *Boundaries (Property), Recreation, Riparian land, Severance, Civil law, Competing uses, Navigable waters, Non-navigable waters, Ownership of beds, Relative rights, Boating, Water sports, Fishing, Lakes, Recreation demand, Water utilization, Navigation, Judicial decisions, Reasonable use, Ponds, Beds, Beds under water, Social needs.
Identifiers: Artificial lakes.

In a recent suit, the riparian owner of a minor portion of a natural lake bed sought to enjoin adjoining owners who prevented him from using the entire lake by erecting physical barriers along their boundary lines. The Florida Supreme Court held that the plaintiff was entitled to a reasonable use of the entire lake for recreational purposes. The court adopted the civil law rule of reasonable use in common with other owners as best suited for Florida in view of the emphasis tourism places on water recreation. Many states cling to the common law view of absolute real property rights which grants to the bed owner exclusive dominion over overlying water. The civil law rule is making an inroad into the absolute concept because of the inconvenience of determining bed and surface boundaries and because of the growing utility the common right concept has for water recreation purposes. In Minnesota the civil law rule has been extended to a mere riparian owner regardless of bed ownership. These two concepts have also been extended in some states to private artificial lakes subject to recreational uses and having more than one riparian owner. (Douberley-Florida)
W70-02901

**CONSTITUTIONAL LAW--NAVIGABLE WATERS--EXTENSION OF THE FEDERAL PEROGATIVE,**
For primary bibliographic entry see Field 04A.
W70-02902

**OWNERSHIP OF LAND UNDER NON-NAVIGABLE LAKE (DUVAL V THOMAS, 114 So 2d 791 (FLA 1959)),**
J. Menalco Solis.
Tul L Rev, Vol 34, No 3, p 641-647, Apr 1960. 7 p, 51 ref.

Descriptors: *Civil law, *Ownership of beds, *Lake beds, *Riparian rights, Florida, Louisiana, Judicial decisions, Boundaries (Property), History, Non-navigable waters, Lakes, Water law, Legal aspects, Foreign countries, Barriers, Reasonable use, Water rights, Prescriptive rights, Relative rights, Riparian land, Usufructuary right, Access routes.
Identifiers: Common law rule.

A corner of plaintiff's land was covered by a segment of a non-navigable, land-locked lake. Abutting property owners had constructed fences which joined in the lake to cut off the plaintiff's access to the major portion of the lake. An injunction was granted to the plaintiff and the fences were ordered removed. The Supreme Court of Florida held that a land-locked, non-navigable lake may be used by all owners of property covered by the lake so long as that use does not unreasonably interfere with the rights of the other proprietors. In so ruling, the court adopted the civil law rule and rejected the common law rule that an owner is restricted to using only that area of a lake within the boundaries of his property. Criticizing this holding, the author traces the development of the civil law in several foreign countries and in the state of Louisiana, and concludes that no known doctrine of the civil law provides authority for the result reached. The rights of the abutting landowners to enclose their property, therefore, should be upheld. (Schram-Florida)
W70-02903

**MICHIGAN, WISCONSIN, NEW ENGLAND AND NEW YORK (WATER RIGHTS LEGISLATION),**
Lynn M. Miller.
Am Water Works Ass'n J, Vol 50, No 10, p 1277-1278, Oct 1958. 2 p.

Descriptors: *Water law, *Water rights, *Cities, *Riparian rights, Water storage, Recreation, Water supply, Natural flow doctrine, Competing uses, Industrial water, Municipal water, Irrigation water, Legislation, Prior appropriation, Dams, Public rights, Irrigation programs, Adoption of practices, Impounded waters, Recreation demand, Water policy, Reasonable use, Water resources, Great ponds, Watershed control, Water use.

A review of trends in water rights legislation reveals that particular water problems are not universal, but local. The areas affected, however, may be relatively large. The rapid expansion of large metropolitan areas has produced particular problems. In Wisconsin and Michigan the greatest impetus to study water rights has been provided by irrigation demands in agricultural areas contiguous to metropolitan areas. The present turmoil here is caused by the lack of statutory water laws. Exhaustive research and study are required before adequate legislation can distribute water rights between municipalities, agriculture, recreation, and industry. A 1957 Wisconsin legislative committee was set up to study these problems. Great conflict has developed over the proposal by agricultural interests to abandon the riparian-rights and public-use principles and substitute the priority allocation philosophy. Although various proposals have been made, the solution appears to lie in storing excess waters during periods of high precipitation. The most significant water rights question in New York and New England is the right of public access to streams and impounded waters for recreational purposes. In Maine, and perhaps many other places, a favorable position now exists towards the public as opposed to the controversial position of the appropriator. (Schram-Florida)
W70-02904

**RIPARIAN RIGHTS--INLAND LAKES,**
Arthur H. Toothman.
U Miami L Rev, Vol 14, No 4, p 689-692, Summer 1960. 4 p, 21 ref.

Descriptors: *Florida, *Boundaries (Property), *Riparian rights, *Ownership of beds, Judicial decisions, Water law, Non-navigable waters, Lakes, Lake beds, Recreation, Legal aspects, Relative rights, Remedies, Water rights, Competing uses, Prescriptive rights, Riparian land, Boundary disputes.

A corner of respondent's property lay underwater in a land-locked, non-navigable lake. The owners of the contiguous tracts erected barriers along the property lines which united at the submerged corner, rendering respondent's sector inadequate for recreational purposes. Respondent sought a mandatory injunction for the removal of the barriers. The Florida Supreme Court granted the injunction, holding that each owner was entitled to use of the entire lake provided that such use did not interfere with the concurrent rights of the other owners. Under the common law, non-tidal, non-navigable lake bottoms were susceptible of private ownership. The owner of a segment of a lake bed, however, was restricted to use of those waters overlying his land. A minority of jurisdictions in the United States have held that each lake bottom owner is entitled to the use of the entire lake. The court, acknowledging the majority view, utilized its judicial discretion to take into account social and economic customs and adopted the more liberal minority viewpoint but labeled it 'civil law.' Because the civil law is broader in scope than the common law theory of riparian rights, Florida will need a further decision to determine the extent of the civil law adopted in this case. (Schram-Florida)
W70-02905

**RAILROAD FERRIES ON LAKE MICHIGAN; STREAMS, HIGHWAYS, RESTORED.**
Wis Stat Ann secs 190.07, 190.08 (1957).

Descriptors: *Wisconsin, *Railroads, *Contracts, *Maintenance, Legislation, Legal aspects, Lake Michigan, Michigan, Transportation, Watercourses (Legal), Canals, Bayous, Rivers, Navigation, Shores, Construction.

Identifiers: *Restoration, Sloughs, Ferries.

Any Wisconsin railroad corporation may contract with the owner of any Michigan railroad which terminates on the eastern shore of Lake Michigan for the joint operation of their railroads. Corporations which operate railroads will restore or maintain every watercourse, road or canal adversely affected by the operation or construction of the railroad to such condition that its usefulness will not be materially impaired. Such railroad corporations may acquire any lands required to restore any watercourse, road, or canal. This section does not apply to sloughs or bayous closed by the government to aid the navigation of rivers. (Keith-Florida)
W70-02909

**BOARD CONTROL OF REPAIR, CONSTRUCTION, AND IMPROVEMENT OF STREETS, SEWERS, SIDEWALKS, AND WATERCOURSES.**

Wis Stat Ann sec 61.36 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Local governments, *Sewers, *Regulation, Watercourses (Legal), Storm drains, Legislation, Administrative agencies, Drains, Structures, Canals, Legal aspects, Highways, Road construction, Construction, Drainage, Drainage practices.

The village board may lay out, alter, extend, improve, repair, or discontinue any municipal roads, streets, alleys, sanitary and storm sewers, parks, and other public grounds. They may construct drains, canals, or sewers, and may alter, widen, or straighten watercourses. Their power extends to the building, alteration, repair, improvement, or discontinuance of any sidewalks and crosswalks as well as to the building and maintenance of roads and sidewalks required to connect the village with any transportation terminal or village property outside of its limits. (Barnett-Florida)
W70-02918

**MISCELLANEOUS HIGHWAY PROVISIONS.**
Wis Stat Ann secs 86.02, 86.022, 86.17 (1957).

Descriptors: *Wisconsin, *Highways, *Drainage systems, *Damages, Ditches, Lumber, Streams, Sluices, Legislation, Legal aspects, Local governments, Regulation, Tunneling, Maintenance, Transportation, Water supply, Water sources, Obstruction to flow.
Identifiers: Penalties (Civil).

Any person who injures a highway by obstructing it, by diverting a watercourse or sluiceway over it, or by any other act, will be liable in treble damages to the political division of the state charged with maintenance of the highway. Willfully obstructing traffic on a public highway by making any ditch or depression in, or by placing any obstruction on such highway is a misdemeanor. The placing of any obstruction in a ditch designed to drain a highway is also prohibited. The general public has the right to use and take water from any spring or creek which runs into or across the limits of any public highway. Such taking, however, must not interfere with the tunneling or piping of water for the purpose of draining or improving lands on either side of the highway. Any person wantonly interfering with the free use of such water shall be guilty of a misdemeanor, and shall be liable to any person injured thereby for all damages sustained. (Barnett-Florida)
W70-02919

**WATERWAYS, BRIDGES AND DAMS USED FOR BRIDGES.**

Wis Stat Ann secs 81.05, 81.38, 81.42 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Channels, *Highways, *Bridge construction, Bridges, Culverts, Administrative agencies, Boats, Navigation, Damages, Construction, Maintenance, Assessments, Costs, Taxes, Creasote, Lumber, Steel, Concrete, Cost sharing, Dams, Cities, Local governments, Transportation.
Identifiers: Navigability.

Town boards of towns with waterways suitable for general and useful navigation may adopt them as public waterways and expend highway funds to improve and maintain their navigability. Special appropriations are required for yearly expenditures in excess of $200.00. Towns are not liable for damages for defects in such waterways. Methods of cost sharing between towns and their counties for the construction and repair of bridges and culverts are described. When necessary, town boards may file petitions with the county highway committee for immediate construction or repairs. Structures shall be constructed of approved materials. Town boards may contract with private owners of dams for the use of such dams as bridges. (Duss-Florida)
W70-02920

**HIGHWAYS, BRIDGES, DRAINS.**

Wis Stat Ann secs 84.10-84.12, 84.14, 84.15 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Bridges, *Highways, *Administration, Bridge construction, Maintenance costs, Assessments, Cost sharing, Administrative decisions, Government, Insurance, Local governments, State governments, Cost repayment, Cost allocation, Administrative agencies.

The allocation of state funds for maintenance and operation of various types of bridges is provided. The State Highway Commission regulates the maintenance and operation of bridges. The Commission may acquire land and easements to be transferred to the federal government for the national parkway system. The eligibility of intrastate bridge projects for funds, procedure for initiating their construction, and the method of apportioning costs among counties and towns are provided. The Commission and the highway department of another state may determine details for bridges crossing state boundary waters. Costs for bridge construction are apportioned between states and benefitted counties within states. Interstate bridge construction is controlled jointly by the highway commissions of involved states. Such bridges become part of the state trunk highway system and are maintained toll-free after repayment of costs. Maintenance costs and Wisconsin's share of interstate bridges are obligations of the state. The state may insure bridges. (Dye-Florida)
W70-02921

**LOCATION OF PIERS.**
Pa Stat Ann tit 55, sec 281 (1964).

Descriptors: *Pennsylvania, *Piers, *Relocation, *Navigable waters, Locating, Legislation, Sites, Navigation, Navigable rivers, Coastal structures, Harbors, Coastal engineering, Engineering structures, Piles, Water policy, Legal aspects.

When any person has been authorized by act of assembly to build a pier in any of the rivers of the state, it is lawful to locate the pier as will best answer his purposes. Any change in the location of the pier is limited within a one hundred foot radius of the original location. In addition, any change of position cannot interfere with the navigation of the river or in any way injure private property. The direction and consent of the port wardens is required to construct a pier in any location where port wardens have been created by law. (Schram-Florida)
W70-02926

**OBSTRUCTIONS IN HARBOR AND REMOVAL THEREOF.**
Pa Stat Ann tit 55, secs 341-348 (1964).

Descriptors: *Pennsylvania, *Harbors, *Navigation, *Navigable rivers, Delaware River, Legislation, Administrative agencies, Wastes, Ships, Boats, Water pollution, Channels, Delaware River Basin Commission, Water law, Legal aspects, Jurisdiction.
Identifiers: *Obstructions to navigation.

After proper notice has been given, the owner of any canal boat, barge, or other vessel sunk in the channel of the Delaware of Schuylkill rivers within the limits of the Port of Philadelphia must remove such obstruction within ten days. Failure to comply subjects the owner to a one hundred dollar fine. In case of refusal or neglect to raise and remove sunken craft, the Harbor Commissioners shall have it removed at the expense of the owner. The removal expenses shall be a lien on the vessel and its cargo until paid. In case the penalty and expenses are not paid, the Commissioners may, after five days notice, sell the vessel and cargo at auction. If there is any deficiency, the President of the Commissioners may sue the owner for the amount of the deficiency. It is unlawful to cast any ballast, cinders, ashes, or any heavy article into the tide-way of the Delaware or Schuylkill rivers. There is a penalty of not more than one hundred dollars for every offense. (Schram-Florida)
W70-02927

**FISHING LICENSES AND THE PENNSYLVANIA FISH COMMISSION.**

Pa Stat Ann tit 30, secs 220-221.1, 229, 249, 250, 252-257, 265, 270, 290-293 (Supp 1969).

Descriptors: *Pennsylvania, *Permits, *Fish conservation, *Administrative agencies, Legislation, Legal aspects, State governments, Fish management, Fishing, Regulation, Control, Fish establishment, Fish reproduction, Fish hatcheries, Fish stocking, Leadership, Government finance, Capital, Fish, Fishing gear, Land tenure, Administration, Administrative costs, Administrative decisions, Wildlife conservation.

As related to fishing licenses, this act provides for: (1) the licensing of specified residents, nonresidents, nonresident aliens, and tourists; (2) license fees; (3) the appropriation of fees to the fish fund of the Pennsylvania Fish Commission; (4) exceptions from license requirements; and (5) complimentary licenses. The Pennsylvania Fish Commission is empowered to appoint assistant executive directors in charge of the Watercraft Safety Division and the Fish Management Division. The act also governs the following: (1) permission to fish for scientific and stocking purposes; (2) free distribution of fish from state fish hatcheries; (3) exclusive use of specified waters by children and disabled persons, and the planting of fish therein; (4) penalties for false representation in procuring fish; (5) which streams and lakes are to be open to the public for fishing; (6) the establishment by the Commission of nursery waters; (7) powers and duties of fish wardens; (8) Sunday fishing; (9) powers of officers to make arrests and destroy unlawful devices; (10) the establishment of a fish license fund and the purposes thereof; (11) the acquisition of lands by the Commission; and (12) donations to the Commission. (Marsee-Florida)
W70-02933

**PORT AUTHORITIES IN COUNTIES OF SECOND CLASS.**
Pa Stat Ann tit 55, secs 551, 553 (1964).

Descriptors: *Pennsylvania, *Port authorities, *Transportation, *Rivers, Harbors, Construction, Eminent domain, Legislation, Local governments, Legal aspects, Water resources development, Zoning, Taxes, Tax rate, Operating costs, Tariff, Maintenance, Maintenance costs, Operating costs, Highways.

The increased commerce and prosperity in second class counties require more effective coordination of transportation facilities, greater utilization of

rivers, and the development of port authorities. Thus, to promote the safety and welfare, a port authority shall be established in each second class county. It is intended that the authority cooperate with and/or acquire existing transportation facilities. Said authorities shall be empowered: (1) to acquire any necessary property or interest therein by purchase, lease, or otherwise, and to construct, improve, maintain, repair, and operate facilities; (2) to make by-laws and regulations for the management of their affairs; (3) to fix, alter, charge, and collect fares, rates, rentals, and other charges for its facilities by zones or otherwise to provide for the expenses of the facility; (4) to borrow money and issue negotiable notes and bonds; (5) to have the power of eminent domain; (6) to pledge or otherwise encumber any revenues of the authority; and (7) to establish carrier routes for the efficient operation of the transportation system. Private rights and property in the beds of existing public highways vacated for the purposes of the authority shall not be deemed destroyed or ousted by reason of such vacation. (Schram-Florida)
W70-02936

**DOCKS AND WHARVES.**
Pa Stat Ann tit 53, secs 16844-16848, 16852, 16854, 16858 (1957).

Descriptors: *Pennsylvania, *Docks, *Port authorities, *Surveys, Bridges, Piers, Piles, Legislation, Administrative agencies, Easements, Permits, Low water mark, Coastal structures, Delaware River, Local governments, Erection, Construction, Navigable rivers, Mapping, Channels, Boundaries (Property), Tidal waters.
Identifiers: Wharf lines.

A four thousand dollar fine is provided for extending or erecting any wharf into the tideway of the Delaware River contrary to this act. An application fee and license fee are authorized for the construction of any wharf on the Delaware or Schuylkill rivers. No district within Philadelphia County shall receive a license to erect such wharves without having filed a plan of the river front bordering such district. The jurisdiction of the Board of Wardens for the Port of Philadelphia is extended to include every navigable stream within Philadelphia County. When any person is licensed pursuant to this act to construct a wharf and said wharf would be erected where any fishing right or easement exists, the licensee may petition the county court. A plan for the establishment of wharf lines, showing the present low-water line, is outlined for Delaware County. After the survey of the Delaware River front is made and the low-water line established, trespassing upon said line shall be punishable by a fine of up to four thousand dollars. (Schram-Florida)
W70-02937

**WIDEN, EXTEND OR RELOCATE HIGHWAYS.**

Pa Stat Ann tit 53, sec 13802 (1957).

Descriptors: *Pennsylvania, *Highways, *Road construction, *Boundaries (Property), Highway relocation, Tunnels, Legislation, Conveyance structures, Bridges, Access routes, Roads, Streams, Interstate streams, Structures, Local governments, Interstate.

Any city of the first class may lay out, widen, extend, or relocate highways that connect with, or are approaches to, bridges or tunnels across streams forming the boundary between this and any other state. The council may also, at its discretion, construct viaducts or other structures or superstructures to carry such highways over other highways and property. Any such improvement, however, must substantially follow the course of the existing streets of the city which are in the most nearly direct continuous line with such bridge or tunnel. (Schram-Florida)
W70-02938

**ACQUISITION OF PROPERTY.**
Va Code Ann sec 33-255.5 (1953).

Descriptors: *Virginia, *Riparian land, *Eminent domain, *Beds under water, Riparian rights, Ownership of beds, Condemnation, Right-of-way, State governments, Legislation.

The State Highway Commission is empowered to acquire lands lying under water and riparian rights as necessary and convenient for any project. Property or property rights may also be acquired by condemnation or be eminent domain when necessary. (Douberley-Florida)
W70-02991

**BRIDGE NOT TO OBSTRUCT NAVIGATION OR FISH.**
Va Code Ann sec 33-216 (1953).

Descriptors: *Virginia, *Bridges, *Navigation, *Fish barriers, Bridge design, Navigable waters, Navigable rivers, Barriers, Fish passages, Engineering structures, Legislation.

Toll bridges authorized by this act must not be constructed so as to obstruct navigation or the passage of fish. (Douberley-Florida)
W70-03005

**SILVER SPRINGS INC V THE CANAL AUTHORITY OF THE STATE OF FLORIDA (USE OF ADVICE FROM THE CORPS OF ENGINEERS).**
226 So 2d 893-894 (I DCA Fla 1969).

Descriptors: *Florida, *Eminent domain, *Decision making, *Recreation, Judicial decisions, Condemnation, Condemnation value, Canals, Planning, Project planning, Coordination, Recreation facilities, Land use.
Identifiers: *Corps of Engineers.

Petitioner sought review by certiorari of an eminent domain proceeding on the grounds that the Canal Authority abused its discretion by allowing the Corps of Engineers to determine the quantity, location, and quantum of the lands to be acquired and the need of the lands for canal purposes. The court refused the writ, holding that the evidence supported the finding that the decision was the independent determination of the Authority. In view of the dominant and integral functions being performed by the Corps of Engineers, it was not an abdication of responsibility to rely heavily upon their expert advice and recommendations. It was alleged that one parcel was intended for recreational purposes only, a purpose which was held to be unauthorized under the statute in a prior decision, but the court found no basis for the contention. If any land was found to be acquired for recreational purposes, it was to have been excluded from the eminent domain proceedings by application to the trial court. (Douberley-Florida)
W70-03025

**MUNICIPAL ELECTRIC ASSOCIATION OF MASSACHUSETTS V FEDERAL POWER COMM'N (REVIEW OF POWERPLANT LICENSE).**

414 F2d 1206-1210 (DC 1969).

Descriptors: *Hydroelectric project licensing, *Standby power, *Water utilization, *Federal Power Act, Pumped storage, Federal project policy, Judicial decisions, Hydroelectric plants, Hydroelectric power, Powerplants, Electric power production, Water utilization, Engineering structures, Electric power demand, Electrical networks, Water distribution (Applied), Future planning (Projected), Project planning, Optimum development plans, Utilities, Non-consumptive use, Reservoirs.

Petitioners contested the awarding of a license by the Federal Power Commission to construct and operate a pumped storage hydroelectric power plant designed to provide power for periods of peak load. The court held that the Commission had not abused its discretion. Since a license to construct a power project authorizes the licensee to appropriate public water resources, the Commission must feel that the project is the highest and best use of the resource before the license may be granted. The court held that the urgent need for the project, the lack of feasible alternatives, and the proposals made for conservation and recreation justified the granting of the license. Although the project was not fitted into a comprehensive power plan for the area, the Commission was within its authority to approve the project. It was claimed that a larger facility was needed, but the Commission was held to be not unreasonable in authorizing the urgently needed smaller facility, since it could be easily expanded. (Douberley-Florida)
W70-03087

**UNITED STATES V 959.68 ACRES OF LAND (ENHANCED VALUE THROUGH CHANGED PROJECT PLANS).**
415 F2d 401-403 (3d Cir 1969).

Descriptors: *Condemnation value, *Appreciation, *Project life, Judicial decisions, Condemnation, Compensation, Economic impact, Value, Market value, Property values, Reservoirs, Planning, Project planning, Programs, Federal project policy, Reservoir sites, Riparian land, Land appraisal, Federal government.

Initial plans for a reservoir project indicated that only the lower portion of the land in question would be taken, but the plan was subsequently changed so that the remaining portion was included in the condemnation proceeding. The Government contested the fact that the amount paid for the upper portion reflected an enhanced evaluation because of its anticipated riparian status created by the project. In affirming the judgment, the court held that payment for the enhanced value was proper. The critical issue was whether it seemed probable when the project was announced and undertaken that it might be enlarged as to include the additional land. It was immaterial that the entire tract was condemned at once rather than acquired in separate portions, or that there was no reliance on the Government's assurances that the upper portion would not be needed. When land near a public project, but not indicated at the outset as probably to be included, is genuinely enhanced by the project, the Government, when it later determines to take these other lands, must pay their enhanced market value. (Douberley-Florida)
W70-03092

**ILLINOIS WATER POLLUTION AND WATER RESOURCES COMMISSION, REPORT AND RECOMMENDATIONS TO GOVERNOR RICHARD B. OGILVIE AND THE 76TH ILLINOIS GENERAL ASSEMBLY.**
Illinois State Water Pollution and Water Resources Commission, Chicago.
For primary bibliographic entry see Field 05G.
W70-03138

**A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART ONE,**
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06C.
W70-03143

**A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART TWO,**
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06C.
W70-03144

**A REVIEW AND REVITALIZATION: CONCEPTS OF GROUNDWATER PRODUCTION**

**AND MANAGEMENT--THE CALIFORNIA EXPERIENCE,**
University of Southern California, Los Angeles. School of Law.
For primary bibliographic entry see Field 04B.
W70-03145

**URBAN STORM DRAINAGE CRITERIA MANUAL.**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

**SUMMARY OF COLORADO DRAINAGE, (Chapter 2), AND PLANNING, (Chapter 3).**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03150

**THE LEGAL FRAMEWORK OF THE ST LAWRENCE SEAWAY,**
M. Cohen, and G. Nadeau.
U Ill L Forum, Vol 1959, No 1, p 29-50, Spring 1959. 22 p, 63 ref.

Descriptors: *St. Lawrence Seaway, *International Joint Commission, *Multiple-purpose projects, *International waters, St. Lawrence River, St. Lawrence Seaway Develop. Corp., Governments, Federal government, Rivers, Inland waterways, River flow, Regulated flow, Dam construction, Hydroelectric power, Hydroelectric plants, International commissions, Great Lakes, International law, Treaties, Locks, Engineering structures, Navigation, Boundary disputes, Cost sharing, Project planning.

The St. Lawrence Seaway has no overall agreement as its legal framework, but is an example of two nations accommodating their common interests in an international watercourse. Political, economic and legal problems were resolved after two generations of negotiations that resulted in a patchwork of international convention arrangements and municipal public law. The cooperative framework for the separate development of power and navigation projects was based on a simple exchange of notes, passage of parallel legislation by each country, and an order of approval from the International Joint Commission (IJC). The Boundary Waters Treaty between the United States and Canada was designed to solve potential problems with relation to boundary waters and rivers running along the boundary. The Treaty established the IJC with judicial, investigative and administrative functions, and its order of approval was the most important basis of cooperation. It provided general rules and created machinery for managing common interests in the waterway construction and in regulating flow levels. Statutes passed by each country deal with liability for damages, and the order of approval allocates costs. Cooperation between the corporations set up by each country to construct the Seaway took the place of a unified authority. (Douberley-Florida)
W70-03178

**AUTHORIZATION TO ACQUIRE LAND FOR INDUSTRIAL PURPOSES AND FOR PORT AND TERMINAL FACILITIES.**
Miss Code Ann sec 7549.7-01 (1956), sec 7557.8 (Supp 1968).

Descriptors: *Mississippi, *Harbors, *Port authorities, *Land reclamation, Land development, Legislation, Administrative agencies, Local governments, Rivers, Bays, Lakes, Boundaries (Property), High water mark, Ownership of beds, Storage, Regulation, Dredging, Land forming, Landfills, Tidal waters, Land tenure, Cities, Land resources, Land use, Legal aspects.

The port commissions of Mississippi have jurisdiction over all land which is now, or was at one time, below the mean high tide mark of any river, bay, or natural lake. This jurisdiction extends to lands adjacent to ports and harbors as well as to lands acquired by lease, purchase, or eminent domain from individuals or corporations by the city or port commission. The commission is authorized to reclaim such lands by filling, dredging, or other means, and to utilize, lease, or dispose of these lands for the development and operation of the port. Any city or county, or both, may acquire or sell land situated in such county, whether within the city limits or not, for industrial purposes or for port, terminal, landing, and storage facilities. For this purpose, the cities and/or counties are empowered to borrow money and issue bonds, notes, or certificates as security. Land bought by a city, or cities, whether alone or jointly with a county, may not be located more than seven miles from the city's corporate boundaries. (Barnett-Florida)
W70-03182

**IMPROVING RAILROADS AND CANALS.**
Pa Stat Ann tit 15, secs 4071, 4081 (1967).

Descriptors: *Pennsylvania, *Canals, *Railroads, *Structures, Docks, Bridges, Piers, Streams, Rivers, Navigation, Navigable waters, Navigable rivers, Transportation, Aqueducts, Stream improvement, Riparian rights, Diversion, Right-of-way, Channel improvement, Cities, Legislation, Legal aspects.
Identifiers: Obstruction to navigation.

Railroad companies may erect docks, wharves and piers in any navigable stream where necessary for public and business purposes. Any such railroad company may also take and hold lands, wharves, docks or piers provided that the navigation in streams or rivers shall not be impeded by said railroad structures. Structures in Philadelphia are restricted by rules applying to that city. For the purpose of securing the safety of property and persons and increasing transportation, any railroad, canal or slack-water navigation company may straighten, widen, deepen, enlarge or otherwise improve their lines of railroads, canals, and slack-water navigation and the bridges, crossings, aqueducts, piers and structures thereof. For the above purposes railroad and navigation companies may purchase, hold, and use, or enter upon and appropriate lands and materials and use of lands for the flow of water diverted by any structure or embankment. (Smith-Florida)
W70-03184

**ACCESS TO CANALS AND NAVIGABLE STREAMS.**

Pa Stat Ann tit 15, secs 4320, 4321, 4324, 4325 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Railroads, *Streams, *Canals, Right-of-way, Transportation, Navigable waters, Navigable rivers, Riparian rights, Access routes, Roads, Mining, Coal mines, Economics, Occupations, Legislation, Legal aspects.

When the owners of any railroad possess the landing where the railroad joins a canal or other navigation, and any lateral railroad is constructed to connect with said railroad for the purpose of using the landing for trade, and the owners of the landing refuse to permit the trade of said lateral railroad, then the county court shall determine the proper fee for an appropriate portion of the landing and shall direct the landing to be open to the public. The users of lateral railroads may procure landings or wharves. Certain wharf owners are exempt from these provisions. This act shall apply to all navigable streams in Armstrong County. It shall be lawful for owners or lessees of iron ore or coal mines to construct lateral railroads from said mines to any railroad, public road, or navigable stream, over or under any intervening lands, provided that no existing mine or county line shall be crossed. These sections were repealed by section 2204 (i) of Title 15 insofar as they relate to business corporations and foreign business corporations. (Smith-Florida)
W70-03185

**WIDTH AND LOCATION OF PIER HEADS.**
Pa Stat Ann tit 53, sec 16866 (1957).

Descriptors: *Pennsylvania, *Piers, *Rivers, *Specifications, Abutments, Coastal structures, Piles (Foundations), Docks, Quality control, Cities, Regulation.

All pier heads hereafter intended to be sunk in the river beyond Wharf Street shall be of a certain stated width and located at a stated distance from the street. The pier shall be composed of good, square timber, well fitted and secure. (Smith-Florida)
W70-03186

**NATIONAL FORESTS IN PENNSYLVANIA.**
Pa Stat Ann tit 32, sec 101 (1967).

Descriptors: *Pennsylvania, *National forests, *Jurisdiction, *Federal government, United States, Water resources development, Federal jurisdiction, State jurisdiction, Federal reservations, Forests, Public lands, Conservation, Condemnation, Administration, Administrative agencies, Legislation, Legal aspects, River basin development, Navigation, Watersheds (Basins), Watershed management, River basin commissions, Navigable rivers, Navigable waters, Streams, Rivers, River basins.

The United States is empowered to acquire by purchase or condemnation such lands in Pennsylvania as may be needed to establish National Forest Reserves. Such power is granted in accordance with an act of Congress enabling any state to cooperate with any other state or with the United States for the protection of watersheds of navigable streams and which provides for the appointment of a commission to acquire lands for conserving the navigability of navigable rivers. (Smith-Florida)
W70-03188

**POWER AND SUPPLY PERMITS.**
Pa Stat Ann tit 32, secs 592-595, 598 (1967).

Descriptors: *Pennsylvania, *Hydroelectric plants, *Dam construction, *Permits, Federal government, Navigable waters, Legislation, Legal aspects, Administration, Management, State governments, Alteration of flow, Obstruction to flow, Electric power production, Hydroelectric project licensing, Islands, Steam, United States, Federal jurisdiction, Administrative agencies, Powerplants, Dams.

Any power dam or change in stream to develop power on navigable waters or affecting the interests of interstate or foreign commerce is within the jurisdiction of the United States. Permits for construction of power dams not within the United States' jurisdiction are valid for fifty years. Permits for the construction of dams on waters within the jurisdiction of the United States are issued by the Water and Power Resources Board, subject to subsequent licensing by the Federal Power Commission. Permits are subject to an annual charge to pay the cost of administering this act. A permit is required in order to use any dam to develop water power for the generation of electric energy for use in public service. Any permittee may, with the consent of the Board, submerge, occupy, use, and overflow any island owned by the Commonwealth appurtenant to the power project. The provisions of this act in relation to production of steam power within the jurisdiction of the United States are suspended until the Federal Power Commission requires licenses for such projects. The Attorney General may institute proceedings to revoke a permit for violations of these provisions. (Barnett-Florida)
W70-03190

**FISHING WITH NETS AND SET LINES.**
Wis Stat Ann secs 29.30, 29.33, 29.336, 29.34, 29.343, 29.35, 29.36, 29.37 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Commercial fishing, *Fish, Wildlife, Gars, Rough fish, Fish conservation, Legislation, Regulation, State governments, Nets, Fyke nets, Gill nets, Fishing gear, Boats, Administrative agencies, Inspection, Inland waterways, Mississippi River, Rivers, Legal aspects, Control.
Identifiers: Licensing.

Restrictions concerning the use of nets and set lines for catching game fish are set forth. Minimum requirements as to size and type, and as to time limitations for the use of certain nets are stipulated. Licenses are required for the use of nets and set lines. Noncompliance with the provisions of this act may cause the license to be revoked or cancelled. Licenses must be procured for commercial fishing in outlying waters. Fees will be assessed for the licenses depending upon the applicant's residency and upon the size of his boat. Special licenses are required for fishing with special equipment for designated species of fish. A license is required to use set or bank poles in inland waterways. The use of set lines must be licensed by the Conservation Commission. The Commission may request reports from any licensees concerning the amounts and kinds of fish caught with set lines. (Barnett-Florida)
W70-03193

**FISH HATCHERIES AND FISH PROPAGATION.**

Wis Stat Ann secs 29.50, 29.51, 29.513, 29.515, 29.52, 29.53, 29.535, 29.536 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Fish hatcheries, *Fish reproduction, *Fish conservation, Legislation, Legal aspects, Ponds, Fish stocking, Permits, Rough fish, Fish barriers, Navigable waters, Beds, Public rights, Water supply, Cities, Mississippi River, Navigation, Regulation, Fish, Fish eggs, Fish management, Administrative agencies.
Identifiers: *Game fish, Trespass, Penalties (Criminal).

The State Conservation Commission is given general charge of the propagation and breeding of fish, the diffusion of useful information relative thereto, and the general management of the state fish hatcheries. No person may remove fish or fish eggs from the state unless he has been issued a permit by the Commission. The Commission may erect barriers to exclude rough fish from the waters of the state provided such barriers will not unreasonably interfere with navigation. Any person owning all of the land bordering on a landlocked navigable lake may apply to the Commission for a permit to remove, destroy, or introduce fish into such lake. Trespassing on state fish hatcheries is a criminal offense. The Commission will issue permits for private fish hatcheries to any owner or lessee of lands suitable for propagating fish. Owners and lessees of particular types of land may, with Commission approval, operate private hatcheries for the purpose of propagating rough fish. To lawfully import fish into the state for stocking purposes, one must obtain a permit from the Commission. Cities may operate fish hatcheries after obtaining permission from the Commission. (Keith-Florida)
W70-03194

**HARBORS AND NAVIGATION.**

Wis Stat Ann secs 30.12, 30.13, 30.15, 30.16, 30.17 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Riparian rights, *Structures, Resource development, Legislation, Legal aspects, Administrative agencies, Regulation, Jurisdiction, Piers, Buoys, Docks, Navigable waters, Beds, Bulkhead line, Navigation, Streams, Obstruction to flow, Recreation, Public rights, Rivers, Canals, Harbors, Construction, Riparian land.
Identifiers: *Riparian owners, *Obstructions to navigation, Pierhead line, Penalties (Criminal).

In the absence of legislative authorization or a permit granted by the Department of Resource Development, it is unlawful to deposit any material or place any structure on the bed of any navigable water where no bulkhead line has been established or beyond a lawfully established bulkhead line. Under certain conditions the Department may grant any riparian owner a permit to build for his own use a structure otherwise prohibited by statute. A permit may likewise be granted to enable a riparian owner to place a layer of sand on a bed adjacent to his property for recreational improvement. Riparian owners may build piers without a permit provided the piers do not interfere with public rights or rights of other riparian owners. Such piers are subject to any established pierhead line. Various types of obstructions to navigation are made unlawful and certain exceptions are noted. Certain governmental units are given authority to remove obstructions to navigation under specified conditions. It is made unlawful to intentionally remove or moor to a government buoy or beacon. (Keith-Florida)
W70-03196

**NAVIGABLE WATERS, HARBORS, AND NAVIGATION.**

Wis Stat Ann secs 30.20-30.25 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Beds, *Water resources development, *Interstate compacts, Legislation, Legal aspects, Navigable waters, Public rights, Cities, Regulation, Water levels, Recreation, Riparian land, Zoning, Federal government, Public utilities, Permits, Dams, Great Lakes, Structures, Water supply, Sewage treatment, Sewage disposal, Navigation, Water pollution control, St. Lawrence Seaway, Harbors.
Identifiers: *Great Lakes Basin Compact, Penalties (Criminal).

A contract from the Department of Resource Development is required in order to remove any material from the beds of navigable lakes or outlying waters. The conditions under which the Department is authorized to grant such contracts are specified. When any lake area becomes unfit for recreational use, the Department may establish zones within which riparian owners may remove material from the lake bed to restore the area to recreational use. Public utilities acting pursuant to municipal permits may construct such structures on beds as are necessary to secure an adequate water supply to the utility, improve navigation or harbor facilities, or generate electricity. Provision is made for the Governor to appoint commissioners to the Wisconsin Great Lakes Compact Commission. It is the duty of the Commissioners to represent the state on the Great Lakes Commission and work for the development of the St. Lawrence Seaway. It is the policy of the state to aid in the accomplishment of the purposes of the Great Lakes Basin Compact. The state accepts the transfer of federal project structures and property on the Upper Fox River. No effort will be made to improve specified portions of the Wolf River. (Keith-Florida)
W70-03198

**WATER, ICE, SEWAGE AND REFUSE.**
For primary bibliographic entry see Field 05G.
W70-03199

**MUNICIPAL CORPORATIONS.**

Ohio Rev Code Ann sec 727.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Assessments, *Cities, *Public utilities, Legislation, Local governments, Costs, Projects, Project benefits, Cost allocation, City planning, Administration, Construction costs, Maintenance costs, Piers, Water storage, Sewers, Drains, Streams, Levees, Structures, Reservoirs, Treatment facilities, Channel improvement.

The legislative authority of a municipal corporation may assess upon the benefitted land a portion of the cost of constructing or improving docks, wharves, piers, sewers, sewage disposal and treatment plants, water treatment plants, reservoirs, water storage tanks, or any other utility works. No part of the cost connected with changing or improving any stream or watercourse, or for constructing or improving any levees or boulevards shall be levied against any land being used solely for off-street parking or solely for single or two family dwellings. (Powell-Florida)
W70-03205

**PUBLIC PARKS AND RECREATION.**
Ohio Rev Code Ann secs 1541.06, 1541.07, 1541.10, 1541.17, 1541.18, (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Parks, *Boating, *Interstate compacts, Legislation, Legal aspects, Bodies of water, Recreation, Fishing, Lakes, Reservoirs, Inspection, Canals, Permits, Safety, Boats, Pennsylvania, Water resources, Dams, Swamps, Water supply, Water conservation, Flood control, Jurisdiction, Water pollution.
Identifiers: *Pymatuning Lake, Penalties (Criminal).

Certain named bodies of water and lands are dedicated and set apart forever for the use of the public as public parks; the lakes named will be open at all times to the public as resorts for recreation and pleasure, including hunting, fishing, and boating. Park officers will have the authority vested by law in constables to keep the peace in public parks, to enforce park regulations, and to make arrests when necessary. Park officers will inspect all boats and watercraft operated upon the waters of any state reservoir, lake, or canal; if such craft are found unsafe, the officer will prohibit further use of the craft and may impound them to enforce this section. (Keith-Florida)
W70-03213

**CANAL LANDS.**

Ohio Rev Code Ann secs 1545.29, 1545.30 (Page 1964).

Descriptors: *Ohio, *Leases, *Canals, *Parks, Legislation, Legal aspects, Income, Contracts, Administrative agencies, Recreation, Recreation facilities, Bodies of water, Water supply, Natural resources, Hydroelectric power, Land use, Land tenure.

State canal lands which have been abandoned for canal use may be leased to any park district by the agency in control of such canal lands. The park districts may sublease these canal lands and waters. The leasing district will insure by the terms of its lease that it may make such improvements on the leased land as will fit the land for public park and recreational uses. This section does not apply to canal lands, land, and bodies of water used or to be used for power, water supply, or other industrial purposes. (Keith-Florida)
W70-03214

**MUNICIPAL CORPORATIONS.**
Ohio Rev Code Ann sec 723.51 (Page 1953).

Descriptors: *Ohio, *Cities, *Streams, *Highway relocation, Routing, Legislation, Local governments, Projects, City planning, Construction, Diversion, Streamflow, Highways, Dams, Aqueducts, Drains, Cisterns, Sewers, Sewage disposal water works, Wells, Pumps, Reservoir sites, Reservoirs.

Any municipal corporation may relocate a road or stream if necessary in the construction of wells, pumps, cisterns, aqueducts, water pipes, dams, reservoirs, reservoir sites, sewers, drains, sewage disposal or water purification plants or water works. (Powell-Florida)
W70-03216

**POWERS OF TOWNSHIP TRUSTEES.**
Ohio Rev Code Ann secs 505.13, 505.26, 505.46 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Local governments, *Boats, *Bridges, Bridge construction, Islands, Taxes, Government finance, Operating costs, Road construction, Construction material, Streams, Rivers, Schools (Education).
Identifiers: *Footbridges.

The board of trustees of any township which is composed in whole or in part of islands accessible from the mainland only by watercraft may levy a property tax to purchase and operate a scow or lighter large enough to carry road building materials. Any board of township trustees may provide for and maintain bridges over its streams. The board may also construct and maintain footbridges over rivers and streams to provide school children convenient access to the public schools. The cost of such footbridges shall not exceed one thousand dollars apiece. (Dearing-Florida)
W70-03217

**ATTORNEY GENERAL LEGAL ADVISER IN CANAL LAND DISPUTES.**

Ohio Rev Code Ann sec 109.11 (Page 1969).

Descriptors: *Ohio, *Canals, *Administrative agencies, *Land tenure, Legal aspects, Surveys, Contracts.

The Attorney General and his assistants shall be the legal advisors of the Department of Public Works and all other state departments in disputes concerning canals, canal basins, and canal lands. He shall examine and perfect title to same. He may contract with surveyors and title examiners in examining and perfecting title in these lands. He shall submit quarterly reports to the Natural Resources Commission and the Legislative Service Commission. (Dearing-Florida)
W70-03218

**REGULATION OF THE TAKING OF CERTAIN FISH FROM THE PUBLIC WATERS OF RHODE ISLAND.**
R I Gen Laws Ann 20-14-1 thru 20-14-5, 20-15-1 (1968).

Descriptors: *Rhode Island, *Striped bass, *Fish, *Atlantic menhaden, Legislation, Commercial fishing, Fish management, Nets, Seines, Trapping, Interstate, Bays, Inlets, Permits, Atlantic Ocean, Size, Fishing, Natural resources, Water resources.

No person, firm or corporation shall take from the public waters of this state any striped bass measuring less than sixteen inches in length. The use of a net, seine, or any other contrivance is prohibited in the taking of striped bass; a hook and line, spear, or authorized fish traps may be used. This chapter does not apply to fish being transported in unbroken packages originating outside, and destined beyond this state's limits. Fines and suspension of fish trap licenses may be imposed upon violators of this act. It is unlawful for anyone to take with purse net or seine any fish commonly known as menhaden, provided that residents and certain Rhode Island corporations may obtain annual licenses to take menhaden. (Casey-Florida)
W70-03220

**COOPERATION IN FEDERAL PROJECTS.**
R I Gen Laws Ann secs 20-2-1 thru 20-2-5 (1968).

Descriptors: *Rhode Island, *Fish management, *Wildlife management, *Administrative agencies, Wildlife, Legislation, Legal aspects, Federal government, Projects, Conservation, Natural resources, United States, Inter-agency cooperation, Regulation, Planning, Programs, Financing.

The United States Fish and Wildlife Service of the Department of the Interior is authorized to conduct fish-cultural work in state waters, and Rhode Island assents to the conduct and establishment of wildlife restoration, fish restoration and management projects as defined by, and in compliance with, federal statutes and regulations. The Division of Conservation, with the approval of the Director of Natural Resources, is authorized and directed to conduct and establish cooperative programs in these areas. Provisions for appropriations and disbursements of state funds are provided. (Casey-Florida)
W70-03224

## 6F. Nonstructural Alternatives

**THE FLOOD CONTROL CONTROVERSY, BIG-DAMS, LITTLE DAMS, AND LAND MANAGEMENT,**
For primary bibliographic entry see Field 04A.
W70-03013

**HAZARD AND CHOICE PERCEPTION IN FLOOD PLAIN MANAGEMENT,**
Chicago Univ., Ill.
Robert W. Kates.
Chicago, Illinois, University of Chicago, 1962. 157 p.

Descriptors: *Floods, *Decision-making, *Nonstructural alternatives, Flood control, Flood damage, Resource management, Flood plains, Economic evaluation, Risks, Planning, Flood protection, Population, Probability, Costs, Economic justification, Regional flood.
Identifiers: *La Follette, Tennessee, *Hazard evaluation, Information availability.

The first chapter of this book is devoted to a restatement of the paradox of greater flood control and increasing flood damages and the alternatives for flood damage reduction. The second chapter is of primary importance to the student of resource management and deals with the relevancy of decision theory and decision-making schema to resource management, particularly flood plains and the reasons for their occupation. The following chapter presents the results of the study performed on the flood problems of La Follette, Tennessee and the decisions of the people of that area along with reconnaissance studies in six other areas. Following this, the type of information available to these areas and its effect on flood control is discussed. The theoretical range of choice perceived by the people is evaluated. The book concludes with a discussion of the role in flood damage reduction played by the decision-making process and the information available to managers. (Murphy-Rutgers)
W70-03017

## 6G. Ecologic Impact of Water Development

**RESOURCES IN AMERICA'S FUTURE,**
Hans H. Landsberg, Leonard L. Fischman, and Joseph L. Fisher.
Baltimore, Maryland, The Johns Hopkins Press, 1963. 1017 p.

Descriptors: *Natural resources, *Demand, *Supply, *Recreation, *Water resources, Land, Mineralogy, Population, Industrial production, Income, Management, Expenditures, Investment, Foods, Textiles, Construction, Transportation, Heat, Crops, Lumber, Metals, Energy.
Identifiers: Labor force, Public policy, Price systems, Clothing, Durable goods, Containers, Packaging, Paper products, Military goods, Woodpulp, Mineral fuels, Nonfuel materials.

One of the great questions before any nation concerns the adequacy of natural resources to provide the kind of living its people desire. Even in the United States, with large resources of land, water, energy, and minerals, one finds concern regarding the over-all adequacy of resources to support the rate of growth of the economy. The core of this book is the projections of demand and supply of natural resources including their products and services as well as the basic land, water, and minerals to the year 2000. The projections make a comprehensive, interrelated system consistent with more general projections of population, labor force, production, and income. The authors feel that the picture that emerges will be helpful to anyone who has the responsibility for, or is interested in, the resources futre of the country. The authors also indicate at many points in the book the problems which loom in the future as a result of lack of correspondence between estimated demand and supply. The closing of these gaps is the business of public policy and private management to the extent that the job is not to be done automatically by the price system. Mainly, however, the book serves as a background for considering policies, not as a treatise on policies themselves. The crucial role of water and water resources in the future growth of the economy makes this book of interest to the water planner. (Loeb-Rutgers)
W70-03009

# 07. RESOURCES DATA

## 7A. Network Design

**ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,**
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
For primary bibliographic entry see Field 06B.
W70-03091

## 7B. Data Acquisition

**MEASUREMENT AND DESCRIPTION OF THE SALINITY OF WATER,**
Hunting Technical Services Ltd., Boreham Wood (England).
T. N. Jewitt.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 2.1-2.22, Sept 1969. 22 p, 8 tab, 7 ref.

Descriptors: *Water quality, *Salinity, *Water chemistry, Hardness (Water), Mineralogy, Water analysis, Aqueous solutions, Saline water systems.
Identifiers: *Australia.

Several standard methods of measuring, classifying, and describing natural saline waters are reviewed and illustrated by examples from studies of Australian waters. Compositions displayed by triangular diagrams, stiff diagrams, and conductivity-concentration plots are compared. (Knapp-USGS)
W70-02853

**THE CHESAPEAKE BAY INSTITUTE WAVE FOLLOWER,**
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Mart Peep, and Ronald J. Flower.
Chesapeake Bay Institute Technical Report 58, Reference No 69-11, Sept 1969. 76 p, 28 fig, 14 ref, 1 append. Contract Nonr 4010 (11); ONR Proj No NR 083-016.

Descriptors: *Instrumentation, *Anemometers, *Waves (Water), *Estuaries, Height, Winds, Flow measurement.
Identifiers: *Wave follower, Hot-wire anemometer, Hot-film anemometer.

The CBI Wave Follower was designed to hold anemometers at fixed distances from 60 cm to 1 cm from a water surface with waves up to 30 cm in height. It allows adjustment for tidal changes in mean water elevation up to 60 cm and for slow vertical scanning. In studies of wave generation an exploration of the wind field close to the water surface is critical. Such an exploration can be made with a hot-wire or film anemometer mounted on a device driven by a servomechanism which will maintain the anemometer at a fixed distance from the fluctuating water surface. (Knapp-USGS)
W70-02872

**EVALUATION OF NUCLEAR METHODS OF DETERMINING SURFACE IN SITU SOIL WATER CONTENT AND DENSITY,**
Corps of Engineers, Vicksburg, Miss. Waterways Experiment Station.
T. B. Rosser, and S. L. Webster.
Report available from Clearinghouse as AD-688 079 for $3.00 in paper copy, $0.65 in microfiche. Corps Engineers Waterways Experiment Station Miscellaneous Paper S-69-15, Apr 1969. 36 p, 2 fig, 16 plate, 7 ref, 1 append. DA Proj No 4A024401A891.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Laboratory tests, On-site tests, Gamma rays, Density, Soil moisture, Soil water, Instrumentation, Moisture content.
Identifiers: Neutron soil moisture meters, Gamma-ray soil moisture meters.

Laboratory tests were made to evaluate accuracy and reliability of measuring surface in situ soil water content and density by the backscatter and direct transmission nuclear methods using a single nuclear device and scaler. The device functioned as a surface backscatter moisture and density meter or as a direct transmission density probe. Five soil types were tested to approximate a full range of possible construction materials. Each soil was tested at 8 different known densities and water contents. To obtain comparative results, soil densities of each sample were determined by 2 accepted conventional field methods (sand-cone and water-balloon). In situ densities by the direct transmission nuclear method using the factory calibration curve furnished with the device were as accurate as densities obtained by the sand-cone and water-balloon methods. The nuclear method using a WES-developed calibration curve provided slightly more accurate density measurements than either conventional method. Densities determined by the surface backscatter nuclear method using both the factory calibration curve and a WES-developed curve were not as accurate as conventional methods. A WES-developed calibration curve was sufficiently accurate for most quality control fieldwork. A test procedure for determining surface layer density and water content of soil by nuclear methods is presented. (Knapp-USGS)
W70-02876

**DELINEATION OF SHEAR ZONES AND APPLICATION TO RESERVOIR ENGINEERING USING APOLLO 9 MULTISPECTRAL PHOTOGRAPHY,**
Alabama Geological Survey, Tuscaloosa.
William J. Powell, Charles W. Copeland, and James A. Drahovzal.
Alabama Geological Survey, Open-file Report, 1970. 51 p, 13 illus, 3 tab, 5 ref.

Descriptors: *Remote sensing, *Water resources, *Infrared radiation, *Structural geology, Hydrogeology, Groundwater, Streamflow, Low flow, Springs, Water wells, Water yield, Faults (Geology), Alabama, Appalachian Mountain Region.
Identifiers: *Lineations, *Multispectral photography, Apollo 9, Coosa River.

One of the most significant features disclosed by the interpretation of the multispectral Apollo 9 space photographs is the relatively straight long lineations that intersect Appalachian structural axis. Because little or no offset in topographic features is evident along most of the traces, the lineations are thought to represent fractures. Orientation analysis suggests that the fractures result from a reoriented stress field developed some time after the main phase of the Appalachian Mountain building. Apparent coincidence of the lineations with areas of known anomalies of streamflow, of large capacity wells and springs, quarry drainage, and dam leakage problems suggests that lineations may not only be of geologic significance but of great hydrologic, environmental, and economic significance. (Lang-USGS)
W70-03069

**SEASONAL VARIATION IN RAIN GAGE CATCH,**
Department of Agriculture, Washington, D.C.; and Weather Bureau, Silver Spring, Md.
J. L. McGuinnes, and Grant W. Vaughan.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21, 1969. 8 p, 2 fig, 2 tab, 11 ref.

Descriptors: *Rain gages, *Precipitation gages, *Calibrations, *Precipitation (Atmospheric), Summer, Winter, Lysimeters, Instrumentation, Rainfall intensity, Seasonal, Nebraska, Ohio, Gaging stations.
Identifiers: Rain gage catch, Rain gage calibration.

In nothern Ohio 8-inch standard rain gages consistently caught more precipitation in summer and less in winter than adjacent digital punch gages, although average annual totals were almost identical. A similar seasonal pattern was found in a comparison of precipitation catch by weighing lysimeters and adjacent weighing-type recording rain gages in Ohio and in a comparison of standard and recording rain gage catch in Nebraska. Some reasons for the differences and their implications are discussed. (Carstea-USGS)
W70-03086

**COMPARISON OF VARIOUS METHODS OF DETERMINING EVAPORATION IN AN IRRIGATED FIELD IN THE VAKHSH VALLEY OF TADZHIKISTAN,**
For primary bibliographic entry see Field 02D.
W70-03116

**ELECTRONICS STARTS SOLVING THE PROBLEMS OF THE CITIES,**
Roger K. Field.
Electronic Design, Vol 16, No 1, p 65-93, Jan 4, 1968. 21 fig.

Descriptors: *Electronic equipment, *Remote sensing, *Remote control, *Technology, *Treatment facilities, Water treatment, Water quality control, Telemetry, Computers, Cities, Urbanization, Municipal water, Municipal wastes, Monitoring.
Identifiers: *Electronic technology, *Advanced technology, Aerospace technology, Urban problems.

This field investigation identifies the design problems involved in applying aerospace technology to today's problems. The major problems that the cities face are lack of money and experience in advanced technology. Adaptation of existing military, aerospace and industrial technology has been successful in a few instances. Examples are Sacramento's water distribution system and sewer maintenance program, Los Angeles' air pollution monitoring and water reclamation programs, San Jose, California's computer-controlled traffic system, New York City's rapid-transit communication and routing system, and Chicago's technologically advanced police department. The municipal functions lending themselves most readily to electronic instrumentation are waste disposal and water reclamation. These functions demand special accurate measuring and sensing devices to quantify factors such as turbidity, biochemical oxygen demand and chemical oxygen demand. They also require strip-chart recording devices to display data on a periodic basis. In Sacramento, water level sensors feed electronic signals to control board to pinpoint the location of water back-up problems. Waterproof TV cameras detect construction flaws in underground pipes. (Poertner-Chicago)
W70-03139

## 7C. Evaluation, Processing and Publication

**EVALUATION OF FLOW IN TIDAL REACHES OF THE CONNECTICUT RIVER BY MATHEMATICAL MODEL,**
Geological Survey, Washington, D.C.; and Geological Survey, Hartford, Conn.
For primary bibliographic entry see Field 02L.
W70-03075

**STANDARDIZATION OF PARTICLE-SIZE RANGES.**
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02J.
W70-03093

**LINEAR ROUTING IN UNIFORM OPEN CHANNELS,**
University Coll., Cork (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03126

**EFFECT OF BASIN MORPHOLOGY ON RESPONSE TO FLOOD FLOWS,**
Oklahoma State Univ., Stillwater. Bioengineering Labs.; and Oklahoma State Univ., Stillwater. Water Resources Research Inst.
M. Hamdy Bechir, Quintin B. Graves, and Anthony F. Gaudy, Jr.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 7, p 46-56, 1967. 11 p, 5 fig, 1 tab. OWRR Project B-006-OKLA.

Descriptors: *Floods, *Illinois, *Computer programs, *Data processing, *Computer models, Streamflow forecasting, Channel morphology, Drainage patterns (Geologic), Flood forecasting, Peak discharge, Synthetic hydrology.
Identifiers: *Illinois River, Drainage basin morphology.

Floods occurring on the Illinois River over the past 30 years were studied, using the United States Geological Survey gaging station records at Tahlequah, Oklahoma. Other gaging stations on the Illinois have partial records covering 10 and 17 year periods. The floods occurring during overlapping period of record were compared and the response was evaluated with respect to flood peak magnitude, length of channel, and morphology of the basin. The comparative behavior of the flows at the gaging stations was incorporated in a computer program. This computer program was used to synthesize flood flows occurring during the period of missing records. (Knapp-USGS)
W70-03127

**A DISPERSION ANALOG MODEL FOR WATERSHED SYSTEMS,**
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 02A.
W70-03128

**A SIMULATED WATERSHED FLOW SYSTEM FOR HYDROGRAPH PREDICTION; A KINEMATIC APPLICATION,**
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-03129

**A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,**
Jaromir Nemec, and Miloslav Moudry.
Proceedings in International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 11, p 80-85, 1967. 6 p, 17 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Analog models, *Hydraulic models, *Mathematical models, Routing, Rainfall disposition, Simulation analysis, Streamflow forecasting, Runoff forecasting.
Identifiers: Watershed models.

In order to evaluate the influence of different elements of the surface runoff process, particularly during flood flow, concentration time is selected as a compound factor. Its variation is analyzed by the use of modeling devices, including the analog electronic model and a physical scale model of a watershed. For electrical modeling the RC electrical analog EMU PR 27, developed by the Hydrometeorological Center of USSR was selected. The theoretical principles and the electronic equivalent of the concentration time are discussed. A simultaneous study of the problem uses a physical scale model of a small experimental watershed, gaged for extended period. The influence of rain intensity on lag time is studied in both models, electronical and physical, as compared with the prototype in nature. (Knapp-USGS)
W70-03135

# 08. ENGINEERING WORKS

## 8A. Structures

**NUCLEAR BLAST RESISTANT WATER WELLS,**
Naval Civil Engineering Lab., Port Hueneme, Calif.
J. A. Norbutas.
Report available from the Clearinghouse as AD-687 704, for $3.00 in paper copy, $0.65 in microfiche. Naval Civil Engineering Laboratory Technical Report R624, Port Hueneme, California, May 1969. 51 p, 10 fig, 3 tab, 35 ref, 5 append. Proj No Y-F011-05-02-353.

Descriptors: *Water wells, *Design, *Nuclear explosions, *Safety, *Construction, Excavation, Nuclear engineering, Seismic waves, Casings, Structural design, Structural engineering, Structural stability.
Identifiers: *Well design, *Well construction, *Blast-resistant wells.

A proposed concept and associated design criteria for blast-resistant water wells are presented. Emphasis is on the design of deep wells for the cooling of hardened shelters. The scope of the study is limited to blast overpressures under 300 psi and weapon yields less than 20 Mt. A unique feature of the concept is the use of a gel-like material to isolate the well casing from blast-induced ground motions. The concept was developed from the results of a survey of reported well damage caused by earthquakes, earth subsidence, and underground detonations; a search of the literature on isolation and hardening techniques; and an analytical study based on existing, unclassified nuclear weapon effects theory. Recommendations are given to field-test the concept and to direct further work toward extending the weapon effects range. (Knapp-USGS)
W70-02865

**THE BUCKLING OF STEEL LININGS IN SHAFTS AND TUNNELS,**
Wartmann et Cie A.G., Brugg (Switzerland).
Ernst Amstutz.
Schweiz Bauztg, Vol 87, No 28, p 541-549, July 1969. Transl from Ger, Bur Reclam Transl 826, Sept 1969. 23 p, 10 fig, 2 tab, 12 ref.

Descriptors: *Tunnel linings, Shafts (Excavations), *Buckling, *Steel linings, Safety factors, Theory, Deformation, Shear forces, Tension, Bending moments, Foreign research, Stress-strain curves, Displacements, Laboratory tests, Model tests, Groundwater, Failure (Mechanics), Pressure, Economics, Foreign design practices.
Identifiers: Switzerland, Grouting pressure, Stiffeners, Slenderness ratio, Test results.

A theory of buckling of circular steel linings in shafts and tunnels, formulated by the author and accepted in technical literature, is presented. Correctly judging the buckling danger of shaft and tunnel steel liners from grout pressure or external water pressure is economically important. According to this theory, relatively small factors of safety are sufficient to prevent failures. Results of buckling experiments performed on test models are compared with computed theoretical values. Good agreement was obtained with the theory for smooth liners and for liners having shear anchors when correct material constants were used in the theoretical formulas. (USBR)
W70-02941

**THE EFFICIENCY OF DOUBLE-SIDED CONTROL DRAINAGE SYSTEMS IN THE UKRAINE (RUSSIAN),**
For primary bibliographic entry see Field 04A.
W70-03119

**COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,**
Chicago Bureau of Engineering, Ill.
For primary bibliographic entry see Field 05G.
W70-03142

**AQUEDUCT CONTROL SYSTEM SAVES $100 MILLION,**
California State Dept. of Water Resources, Sacramento.
Alfred R. Golze.
Power Engineering, p 30-35, Oct 1969. 2 fig, 3 ref.

Descriptors: *Aqueducts, *Water conveyance, *Water delivery, *Water supply, *Water resources development, *Water transfer, Water structure, Water shortage, Construction, Computers, Automatic control.
Identifiers: *California, *Southern California, California Department of Water Resources.

The article describes the concepts and progress of the California State Water Project, the first statewide water resources development in the United States. It is the largest single hydro project in the world to be financed at one time. The estimated cost is over $2.6 billion. An estimated 70 per cent of the State's rainfall occurs north of San Francisco. The project includes construction of a 450 mile aqueduct to transport this water to the drier areas in southern California. Construction began in 1961 and is near the halfway mark. The eight power generating facilities along the waterway will provide a maximum annual output of 6.2 billion kilowatt hours. In the overall system there will be 27 pumping stations and power plants having a total of 170 separate electrical-mechanical units; 66 check structures with 213 separate gates; and a minimum of 49 major water turnout structures where deliveries will be made to customers. Each of the pumping plants has been designed for computer control and each is interfaced with the aqueduct control system so that remote manual or computer control of each plant is possible. The completion date is set for 1972. (Poertner-Chicago)
W70-03146

**URBAN STORM DRAINAGE CRITERIA MANUAL.**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

**STORM SEWERS (Chapter 6); STREETS AND INTERSECTIONS (Chapter 7); AND STORM WATER INLETS (Chapter 8).**
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03152

## 8B. Hydraulics

**THE MOVEMENT OF SALINE/FRESH WATER SYSTEMS,**
Adelaide Univ. (Australia). Dept. of Civil Engineering.
R. Culver.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 5.1-5.10, Sept 1969. 10 p, 1 fig, 10 ref.

Descriptors: *Stratified flow, *Density stratification, *Saline water systems, Open channel flow, Porous media, Groundwater movement, Interfaces, Diffusion, Dispersion, Mixing, Saline water-freshwater interfaces, Boundary processes, Shear drag.
Identifiers: Saline-freshwater systems.

The elements of the mechanics of movement of saline-freshwater systems in free water bodies and in porous media are outlined. Methods are presented for calculation of stratified flow, diffusion, interface behavior, dispersion, and mixing in free, open channel, and conduit flows. (Knapp-USGS)
W70-02855

**LAND SUBSIDENCE DUE TO WITHDRAWAL OF FLUIDS,**
Geological Survey, Sacramento, Calif.; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-02861

**RESPONSE OF A LABORATORY ALLUVIAL CHANNEL TO CHANGES OF HYDRAULIC AND SEDIMENT-TRANSPORT VARIABLES,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-02880

**A METHOD OF ANALYZING TRANSIENT FLUID IN MULTILAYERED AQUIFERS,**
Pahlavi Univ., Shiraz (Iran); California Univ., Berkeley.
For primary bibliographic entry see Field 02F.
W70-02943

**NEEDLE VALVES AS PRESSURE REGULATORS,**
Colorado State Univ., Fort Collins.
J. Paul Tullis, and Maurice L. Albertson.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1633-1649, Sept 1969. 17 p, 7 fig, 13 ref, append.

Descriptors: *Cavitation, *Pressure regulators, *Needle valves, *Energy dissipation, Jets, Hydraulic gates and valves, Closed conduits, Valves, Hydraulics, Water control, Research and development, Erosion, Fluid mechanics, Laboratory tests, Orifices, Submerged orifices.
Identifiers: *Energy dissipators, Cavitation control, Submerged flow, Test results, Cavitation index.

The potential of needle valves issuing into sudden expansions as primary components of large closed conduit pressure regulating structures is analyzed. Results of research projects conducted to evaluate hydraulic characteristics of needle valves are presented. Flow characteristics of the needle valve are described by presenting a submerged jet issuing from a circular orifice into an expansion chamber. Basic principles and equations of fluid mechanics are applied to predict qualitatively the cavitation, pressure fluctuation, and energy dissipation capa-

bilities of submerged jets. A literature review of related studies is presented, and a description of facilities used for testing is given. Tests indicate that needle valves are ideally suited for pressure regulation in closed conduit systems, having the capability of dissipating large amounts of energy with little cavitation or pressure fluctuation. Special attention should be given to the design to maximize the streamlining of the valve and to eliminate the possibility of local cavitation zones. (USBR)
W70-02960

**DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,**
Hydronautics, Inc., Laurel, Md.
Gedeon Dagan.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1699-1712, Sept 1969. 14 p, 3 fig, 20 ref, 2 append.

Descriptors: *Dispersion, *Turbulent flow, *Streamflow, *Channel flow, *Uniform flow, Hydraulics, Thermal pollution, Two-dimensional, Reynolds number, Three-dimensional, Bibliographies.
Identifiers: *Thermal diffusion, Isovels.

The turbulent mixing of a solute in a streamflow is described with the aid of the dispersivity tensor. In a 2-dimensional pipe or wide channel flow, only the radial (vertical) dispersivity coefficient is significant and is usually determined through the Reynolds analogy. The analogy is extended to a 3-dimensional (channel of arbitrary section) uniform flow. The mixing length theory leads to the representation of the dispersivity tensor in terms of 2 distinct coefficients: (1) a coefficient representing mixing normal to isovels found through Reynolds analogy; and (2) a lateral dispersivity coefficient that must be determined from dispersivity measurements. (USBR)
W70-02962

**MECHANICS OF FLOW FROM STRATIFIED RESERVOIRS IN THE INTEREST OF WATER QUALITY; HYDRAULIC LABORATORY INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Joseph P. Bohan, and John L. Grace, Jr.
Waterways Experiment Station, Technical Report H-69-10, July 1969. 84 p, 12 tab, 23 ref.

Descriptors: Computer programs, *Hydraulic models, Intakes structures, *Reservoirs, *Stratified flow, Water quality.

Investigations were conducted to determine the characteristics of the withdrawal zone resulting from the release of flow through an orifice from a randomly stratified reservoir in experimental facilities for the purpose of developing means of predicting the quality of water discharged through similar openings in prototype intake structures. Distributions of density, generated by differentials in both temperature and dissolved salt concentration, and velocity were observed at various locations within a 1-ft-wide channel upstream of 0.08and 0.16-ft-square orifices. These data were used to develop generalized expressions describing the limits of the zone of withdrawal and the distribution of velocities therein. In certain cases, the proximity of the free surface and/or bottom boundary may dictate the upper and/or lower limits of the zone of withdrawal. Means were developed (Appendix A) for evaluating the conditions under which these boundaries dictate the limits of the withdrawal zone and for determining the distribution of velocities within a zone of withdrawal restricted by boundary conditions. A sample problem (Appendix B) is presented to illustrate application of the results to determine the maximum discharge that may be released through a square orifice for a given set of conditions without exceeding the limits of a desired hypothetical zone of withdrawal. The example also illustrates how the actual limits of the zone of withdrawal and the velocity distribution therein are determined. A method is illustrated for predicting the dissolved oxygen content and/or other water quality parameters of the outflow provided the vertical distributions of these parameters in the reservoir are known. A FORTRAN IV program is presented in Appendix C. This program can be used to solve three different approaches to the selective withdrawal problem: (1) determination of the allowable discharge for selected withdrawal limits and orifice size and elevation; (2) determination of the withdrawal zone characteristics for a selected discharge and orifice size and elevation; and (3) determination of the allowable discharge and orifice elevation for selected withdrawal limits and orifice size. The density and/or temperature profile in the reservoir must be known or assumed for all three conditions. The effect of orifice shape on the withdrawal characteristics was tested and analyzed after the draft of this report was prepared. The results were believed to be pertinent and are discussed briefly in the Discussion section of this report.
W70-03027

**WEBBERS FALLS LOCK AND DAM, ARKANSAS RIVER NAVIGATION PROJECT; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
John J. Franco, and James E. Glover.
Waterways Experiment Station, Technical Report H-69-11, Aug 1969. 41 p.

Descriptors: *Channel flow, *Hydraulic models, Locks, Navigation.
Identifiers: *Arkansas River, *Navigation dams, Webbers Falls Lock and Dam.

Webbers Falls Lock and Dam will comprise a nonnavigable dam of 12 gated spillway bays, a 110- by 600-ft lock on the left bank, and a three-unit powerhouse with a discharge capacity of 35,500 cfs on the right bank. A 1:120-scale fixed-bed model was used to determine flood stages at the dam, navigation conditions in the lock approaches, tendency for sediment deposition in the lower lock approach, and magnitude of surges generated in the upper lock approach canal by lock filling, and to develop modifications required to provide satisfactory conditions. Modifications to the original design required to produce satisfactory navigation conditions in the approaches to the lock were developed and flow conditions through the spillway were improved. In general, results have indicated: Realignment of the entrance to the upper lock approach canal would be required to eliminate hazardous conditions for downbound tows attempting to enter the canal. Ports would be required in the upper guard wall to reduce crosscurrents near the entrance to the upper lock approach canal and to reduce surges resulting from lock filling operations. Surges would develop in the upper lock approach canal from lock filling operations. Magnitude of the surge could be reduced so that it would have no serious effect on navigation with ports in the upper guard wall and a surge basin near the lock. Water-surface elevations at the dam embankment to the left of the lock could be lowered by structures designed to eliminate overbank flow toward the embankment and improve the alignment of currents approaching the spillway. Sediment below the dam would be moved into the lower approach channel and could produce shoaling. Size of the surge basin and length of the upper guard wall could be reduced without any appreciable effect on navigation. The amount of excavation in the approach to the spillway could be reduced appreciably without affecting flow through the spillway.
W70-03028

**GALVESTON BAY HURRICANE SURGE STUDY; REPORT 1, EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Noble J. Brogdon, Jr.
Waterways Experiment Station, Technical Report H-69-12, (Report 1), Sept 1969. 167 p.

Descriptors: *Hurricanes, Floods, *Hydraulic models, *Surges.
Identifiers: *Galveston Bay, *Hurricane barriers.

Design of barriers for protection of all or portions of Galveston Bay against inundation by hurricane surges required the use of hydraulic model studies of the Galveston Bay complex to verify the results of surge routings by analytical methods and to determine the effects of all proposed structures on normal tides and hurricane surge heights upstream and downstream from barrier sites. The Galveston Bay hurricane surge model reproduced the coast from Freeport on the south to High Island on Bolivar Peninsula on the east. The model included an average width of the Gulf of Mexico of about 25 miles, measured normal to the gulf; all of the barrier islands in the bay interior, including its many connecting arms, lakes, and lagoons; and the coastal area within this sector up to a maximum elevation of 20 ft msl; and reproduced normal tides as well as gulf surges created by hurricane forces. The model was of the fixed-bed type molded of concrete to linear scale ratios, model to prototype, of 1:100 vertically and 1:3000 horizontally. Automatic tide generators reproduced normal tides and tidal currents throughout the model. Hurricane surges were reproduced by a horizontal-displacement type surge generator. Either of the two major hurricane protection plans tested would provide protection for the area inland from the barrier when the navigation openings were closed. The Alpha plan, located on the coastline of the Gulf of Mexico, would provide protection for a greater area since it shelters practically the entire area inland from the coastline. The Gamma plan leaves unprotected a major portion of West Bay, the entire city of Galveston, and all of East Bay. The Texas City, LaMarque-Hitchcock system, when completed, will provide protection for these towns from surges of 15 ft msl.
W70-03029

**LOW-WATER WEIRS ON BOEUF AND TENSAS RIVERS, BAYOU MACON, AND BIG AND COLEWA CREEKS, ARKANSAS AND LOUISIANA; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Jackson H. Ables, Jr., and Marden B. Boyd.
Waterways Experiment Station, Technical Report H-69-13, Oct 1969. 41 p, 2 tab, 10 photo, 10 fig, append.

Descriptors: *Channel improvement, *Hydraulic models, Riprap, *Weirs.
Identifiers: Big Creek, Ark.; Boeuf River, Colewa Creek, Ark.; Macon Bayou, Tensas River.

A 1:20-scale model reproducing one-half of the channel section through a low-water weir was used to test eight plans of channel improvement. The tests were conducted with a drop height of 5.5 ft, and discharges up to 10,000 cfs were observed. Flow conditions and slope protection downstream from the weir to control the flanking problem were found to be satisfactory with channel improvement plans 6 and 8. Riprap with an average weight of 33 lb was used in slope protection in both plans. A model headwater-tailwater rating curve was obtained. A second 1:20-scale section model was constructed in a 2.5-ft-wide glass flume for more generalized riprap tests in the vicinity of the structure. Several drop structure plans were observed to develop an effective, economical drop structure. Of primary concern were development of some of the dimensions of various elements of the structure and determination of riprap requirements in the vicinity of the structure. Limiting tailwater curves for 220- and 325-lb riprap are furnished as a guide in riprap selection at drop structures with drop heights of from 5 to 10 ft. Suggestions as to the use of these curves also are included. A basin length of 20 ft is considered to be adequate at projects where the jet will ride through at unit discharges exceed-

ing about 10 cfs. It is recommended that the entire 20 ft be protected by riprap of the same size, whether 220- or 325-lb stone. A riprap plan which provides additional protection to the structure is presented in Appendix A. This plan was not considered warranted for initial construction because of increased cost. However, at weirs where maintenance is required it is planned that this work be performed so as to approach the riprap configuration proposed in Appendix A.
W70-03030

**OUTLET WORKS FOR NEW HOPE RESERVOIR, CAPE FEAR RIVER BASIN, NORTH CAROLINA, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Edwin S. Melsheimer, and Noel R. Oswalt.
Waterways Experiment Station Technical Report H-69-14, Oct 1969. 4 tab, 5 photo, 14 fig. 46 p.

Descriptors: *Hydraulic models, *Outlet works, Stilling basins, Flow, North Carolina.
Identifiers: *New Hope Reservoir, Cape Fear River Basin.

Model investigation of the outlet works for the New Hope Reservoir was initially concerned with verification and improvement of the hydraulic design of the intake structure, conduit, and stilling basin. Subsequent tests involved observations of the effectiveness of the multilevel intakes in providing selective withdrawal of flow from the epilimnion or upper stratum of a stratified reservoir. The study was conducted in a 1:20-scale model of the outlet works which reproduced a portion of the approach area, the intake structure, the outlet conduit, the hydraulic-jump type stilling basin, and approximately 800 ft of exit channel. The proposed intake structure provided effective regulation of flood-control releases as well as those which are desired to to provide quality water downstream during both summer and winter. However, certain operational procedures are necessary to prevent dangerous subatmospheric pressures in the throat section of the water-quality system. Flow conditions in the original conduit intakes, throughout the flood-control facilities, and downstream to the conduit outlet were satisfactory with pressure conditions remaining positive for all discharges with little or no fluctuation. There was no tendency for structural vibration with either flood-control or water-quality flows. Performance of the original design stilling basin was unacceptable as unstable hydraulic action and eddy formation resulted in very turbulent basin conditions with little or no energy dissipation. Raising the elevation of the basin and lengthening and modifying the transition section (types 2 and 3 basins) resulted in adequate, if not ideal, performance. Single gate operation produced unbalanced flow in the basin; however, as single gate operation is rarely necessary, types 2 and 3 basins are considered acceptable for prototype construction. It was determined that riprap protection is required on both banks of the exit channel.
W70-03031

**SPILLWAY FOR HUGO DAM, KIAMICHI RIVER, OKLAHOMA; HYDRAULIC INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Bobby P. Fletcher, and John L. Grace, Jr.
Waterways Experiment Station Technical Report H-69-15, Nov 1969. 55 p, 1 tab, 14 photo, 24 fig.

Descriptors: *Hydraulic models, *Spillways, Kiamichi River, Oklahoma.
Identifiers: *Hugo Dam.

Model investigations were conducted to determine the adequacy of a gravity type spillway to be located on the Kiamichi River, Okla., for flood control, water supply, recreation, and fish and wildlife purposes. The investigation of the Hugo Dam spillway were primarily concerned with flow conditions in the approach channel, stilling basin, and exit channel. The model indicated that features of the original design structure were unsatisfactory; however, certain modifications that improved hydraulic performance and reduced construction costs were developed. The capacity of the spillway as determined with the model was greater than that computed. Subsequent modifications to the spillway design to effect economy and eliminate surging at the abutments did not affect the capacity. The performance of the original design stilling basin was satisfactory in the dissipation of all spillway discharges. However, alternate designs were developed to reduce construction costs without impairing hydraulic performance. The size and placement of riprap in the approach and exit channel were determined by model tests.
W70-03032

**CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK; HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
William H. Bobb, and Robert A. Boland, Jr.
Waterways Experiment Station, Technical Report H-69-16, Nov 1969. 261 p, 1 tab, 13 photo, 206 fig.

Descriptors: *Channel improvements, *Hydraulic models, Littoral drift, Shoals, New York.
Identifiers: *Fire Island Inlet, N.Y.

Fire Island Inlet, located on the south shore of Long Island, N.Y., connects the Atlantic Ocean with Great South Bay. The inlet is about 3 miles long and approximately 1/2 mile wide, extending generally east and west between Oak Beach on the north and the western end of Fire Island on the south. Great South Bay, to which Fire Island Inlet is the main entrance, is a tidal body 25 miles long and 2 to 5 miles wide with a general depth of about 6 to 25 ft at mlw. Attempts have been made to stabilize an entrance channel through Fire Island Inlet with little success. To study this problem a fixed-bed model (later converted to a movable-bed model) was constructed to scale ratios of 1:500 horizontally and 1:100 vertically, reproducing all of Fire Island Inlet and a portion of the Atlantic Ocean. Tides, tidal currents, and wave action in the Atlantic Ocean were reproduced. Results indicated that the plan originally recommended by the New York District, which included a littoral drift trap located in the entrance to the inlet, a rehandling basin in the inlet, a connecting channel of adequate depth for navigation by a loaded hopper dredge, and a 500-ft extension to the Federal Jetty, if modified to include a larger rehandling basin but without extension of the Federal Jetty, would meet all requirements for a combination scheme to stabilize the entrance channel and permit bypassing sand to downdrift beaches by means of conventional dredging plant. The construction of groins, deflection dikes, and closure dikes would not appreciably improve conditions obtained by the recommended plan alone. A plan involving an offshore breakwater and a littoral drift trap located between the breakwater and the beach would also function satisfactorily in every respect.
W70-03033

**HYDRAULIC COMPUTATION OF FLOOD-PLAIN CHANNELS,**
Le Van Kiyen.
Transl from Gidrotekhnika i Melioratsiya, No 9, p 50-52, 1968. Soviet Hydrology: Selected Papers, No 4, p 360-362, 1968. 1 tab, 3 ref.

Descriptors: *Channels, *Channel morphology, Flood plains, Rivers, Hydraulic properties, Chezy equation, Flood forecasting, Streamflow forecasting, Hydraulics, Model studies, Hydraulic models.
Identifiers: *USSR.

Field observations and over 300 laboratory experiments were used in the Hydraulic Laboratory of the Moscow Hydrometeorological Institute in order to obtain data for hydraulic computation of flood-plain channels. Two dimensionless coefficients allow for the main characteristics of the flood-plain channel. Formulas for computation are given and discussed. (Carstea-USGS)
W70-03113

## 8C. Hydraulic Machinery

**THE USES OF TURBINE INLET VALVES,**
R. E. Passmore.
Water Power, Vol 21, No 9, p 347-351, Sept 1969. 5 p, 2 fig, 1 tab, append.

Descriptors: *Hydraulic turbines, Penstocks, *Hydraulic gates and valves, Intake gates, *Leakage, Benefits, Economics, Investigations, Repairing, Maintenance costs, Foreign research, Intake structures, Bulkhead gates, Gate seals, Costs, Hydraulic equipment, *Hydraulic valves.
Identifiers: *Wicket gates, Canada, Hydraulic pressure, Headworks.

When studies for hydroelectric developments show the most suitable scheme to be one having individual penstocks to each unit, inlet valves are not required for turbine isolation; then, inclusion of the valves must be justified on another basis. Shutoff devices at or immediately ahead of the turbine gates will prevent wear and provide additional benefits. Requirements for and economic justification of a shutoff device must be examined. Valve installation is required: (1) for unit isolation; (2) for penstock or power conduit protection; (3) for replacement of intake gates; or (4) for isolation of turbines from individual penstocks. The possible need for valves is examined for the situation covered by factor (4), and a formula is given for determining the annual cost of losses incurred by leakage through the turbine wicket gates when no inlet valve is provided. (USBR)
W70-02947

**ENVIRONMENTAL CONSIDERATIONS IN DESIGN OF TRANSMISSION LINES,**
Bureau of Reclamation, Denver, Colo.
Harry Brenman, and Dwight A. Covington.
Prepr 927, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 28 p, 13 fig, 3 ref, append.

Descriptors: *Aesthetics, *Transmission towers, *Transmission lines, Construction, Design, *Environmental engineering, Impact environment, Natural resources, Landscaping, Revegetation, Access roads, Maintenance, Power operation and maintenance, Right-of-way, Clearing.
Identifiers: Landscapes, *Beautification, Bureau of Reclamation.

The electric power industry has an important responsibility in facing up to the demands that have been alerted by the impact of our installations on the surroundings. The prime objective of transmission lines is to establish and maintain reliable electric service. However, the time has come when the environment in which we live must also be considered. Transmission line engineers must: (1) consider alinement and tower appearance in the design stage; (2) integrate, blend, and conceal the line with the surrounding environment; and (3) develop aesthetically acceptable structures. (USBR)
W70-02948

**ALUMINUM VS STEEL IN TRANSMISSION LINE STRUCTURES,**
L. A. Kirkpatrick.
Metal Progr, Vol 96, No 3, p 82-84, Sept 1969. 3 p, 2 fig.

Descriptors: *Transmission towers, *Guyed towers, *Aluminum, Optimum design, Electric power, Helicopters, Costs, Cost comparisons, Transmission (Electrical), Maintenance costs, Foreign design practices, Footings, Erection, Transportation.

Identifiers: *Aluminum towers, *Galvanized steel, *Comparative studies, Canada, Aluminum V-towers.

Aluminum transmission line towers have made inroads into the field of transmission line construction. Design innovations that have evolved are: (1) pinning the legs to the lower chord of the crossarm rather than extending the legs through the crossarm to the ground wire peaks; (2) using 8 guys to 4 anchors to aid in balancing leg loads and optimizing design; (3) using a Y-configuration with 8 guys as a means of minimizing leg sections; and (4) developing a pin connection at the junction of the Y combined with 8 guys to produce a structure having maximum ability to withstand transverse loads. Advantages of aluminum towers are discussed and ways that aluminum can compete with galvanized steel are reviewed. Initially, costs will be higher for aluminum towers than for steel towers, but a complete evaluation in determining the optimum structure for the installation is required. Expanding use of helicopters in transmission line construction will effect many savings. (USBR)
W70-02951

**CHALLENGES OF UNDERGROUND TRANSMISSION AND DISTRIBUTION,**
Commonwealth Edison Co., Northbrook, Ill.; and Commonwealth Edison Co., Maywood, Ill.
D. W. Gilman, and E. J. Steeve.
Prepr 956, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 14 p, 2 fig.

Descriptors: *Transmission (Electrical), *Transmission lines, *Electric power industry, Electric power costs, Costs, Electric power, Reliability, Design, Aesthetic, Right-of-way, Research and development, Environmental effects, Heat transfer, Economics, Electric insulation, Faults (Electrical), Failure (Power), Technology.
Identifiers: *Underground cables, *Underground transmission lines, Pipe-type cables, *Buried cables, Service life, Dielectric properties.

Transmitting electrical energy beneath the surface of the earth presents many challenges. The problems of capacity, reliability, and security seem to defy economic solution with present technology. The electric power industry has undertaken an expanded research effort aimed at removing the barriers to underground powerlines. Two primary motivations for underground transmission are the increasing cost of right-of-way space and the aesthetic compatibility with the environment. Basic differences between overhead and underground lines are described to clarify the engineering and construction problems in economically matching an underground cable to an equivalent overhead line. An understanding of the fundamentals of underground cable design leads to an appreciation of the challenges of undergrounding. Transporting electric energy is divided into 2 subclassifications, distribution and transmission. Costs of underground residential distribution (URD) have been reduced to where this type of curcuit is being widely used. The reliability of several high-voltage underground installations is noted. The cost of underground distribution and transmission lines is discussed and a line cost vs line capability graph presented. (USBR)
W70-02957

## 8D. Soil Mechanics

**THE EFFICIENCY OF HORIZONTAL DRAINAGE LAYERS FOR ACCELERATING CONSOLIDATION OF CLAY EMBANKMENTS,**
King's Coll., London (England).
R. E. Gibson, and Gilliane C. Shefford.
Bldg Res Sta Curr Pap, CP 24/69, p 327-335, June 1969. 9 p, 7 fig, 2 tab, 7 ref.

Descriptors: *Consolidation, *Drains, *Clays, *Embankments, *Horizontal drains, Drainage, Drainage practices, Pore water pressures, Drainage systems, Earth dams, Efficiencies, Permeability, Pore pressure, Pressure distribution, Design criteria, Soil engineering, Stabilization, Fills, Soil mechanics, Foreign research.
Identifiers: Drain spacing soil characteristics, Great Britain.

Efficiency of drainage layers in accelerating consolidation of clay embankments is considered and the influence of such factors as layer thickness, length, and permeability is examined. In order to be fully effective, a drain should have a permeability at least 1,000,000 times that of the surrounding clay fill, although an acceptable efficiency would be achieved with a ratio of about 30,000. A drainage blanket only 1,000 times more pervious than the fill is probably useless. (USBR)
W70-02953

## 8E. Rock Mechanics and Geology

**THE EFFECT OF SATURATION ON VELOCITY IN LOW POROSITY ROCKS,**
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
Amos Nur, and Gene Simmons.
Earth and Planetary Science Letters, Vol 7, No 2, p 183-193, Nov 1969. 11 p, 6 fig, 3 tab, 24 ref.

Descriptors: *Seismic studies, *Seismic properties, *Velocity, *Porous media, *Saturation, Fractures (Geology), Vibrations, Sound waves, Geophysics, Rocks, Geology, Rock properties, Voids.
Identifiers: Seismic velocity-pore geometry relations.

Seismic velocities are often significantly lower near atmospheric pressure than at pressures of a few kilobars in dry rocks with fracture porosity. When such cracks are filled with water, however, this lowering of velocity is significantly diminished for compressional waves. In contrast shear velocity is unaffected by the presence of fluid; low velocity persists at low pressure. The shape of the pores in typical crystalline rocks plays an important role: increase in compressional velocity due to saturation of pores occurs when the pores are in the form of cracks but not when they are in the form of round holes. As differences in compressional velocity of dry and saturated rock at low pressure may approach 50%, the degree of saturation of rocks must be taken into account in many engineering and shallow seismic applications. (Knapp-USGS)
W70-02862

**THE EFFECT OF VISCOSITY OF A FLUID PHASE ON VELOCITY IN LOW POROSITY ROCKS,**
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
Amos Nur, and Gene Simmons.
Earth and Planetary Science Letters, Vol 7, No 2, p 99-108, Nov 1969. 10 p, 5 fig, 2 tab, 35 ref. AEC Contract No AT (30-1)-3966.

Descriptors: *Seismic studies, *Seismic properties, *Velocity, *Viscosity, *Porous media, Fractures (Geology), Vibrations, Saturation, Sound waves, Geophysics, Rocks, Geology, Rock properties, Voids.
Identifiers: Seismic velocity-porefluid relations.

The effective shear modulus of a low porosity rock depends strongly on the viscosity of any fluid phase present in the microcracks. The bulk modulus is essentially independent. These results applied to the earth show remarkable agreement between the laboratory data and the facts known about the velocity zone in the upper mantle. (Knapp-USGS)
W70-02863

## 8F. Concrete

**CALCULATIONS FOR PRESTRESSED PRESSURE TUNNEL LININGS,**
Z. Radosavljevic.
Trans, Inst Vodoprivredu Jaroslav Cerni, Vol 14, No 44, p 13-24, 1968. 12 p, 7 fig, 3 tab, 3 ref.

Descriptors: *Pressure tunnels, Prestressed concrete, *Tunnel linings, *Prestressing, Tunnel design, Tunnel pressures, Grouting, Stress, Radial stress, *Stress relieving, Elastic deformation, Shrinkage, Calculations, Creep, Deformation, Cement grouting, Tunnels, Rock properties, Rock mechanics, Equations, Foreign design practices.
Identifiers: Pressure effects, *Stress relaxation, *Concrete linings, Concrete properties, Yugoslavia, Rama Hydroelec Proj (Yugoslavia).

Conventional concrete linings are not satisfactory for high-pressure tunnels because high pressures lead to cracking of concrete and a consequent rise in permeability. The requirement of impermeability is met primarily by using linings that are prestressed by a corset of high-pressure cement grouting, leading to a permanent state of compressive stress. To determine the necessary prestressing, the amount of stress relaxation that will occur must be determined. Prestressed linings exhibit stress relaxation because of (1) creep in the linings; (2) concrete shrinkage; (3) rock creep; and (4) shrinking, creep, and expansion of the hardened cement grout. Equations and sample calculations are given for determining stress relaxation. The pressure drop for prestressed linings lies within the 50-80% range and is primarily caused by creep in the concrete; next in order of influence are concrete shrinkage and low deformability of the rock. The influence of the elasticity, shrinkage, and creep of the hardened grout, and of the gap between lining and rock amounts to less than 3% and can be neglected in comparison with other factors. (USBR)
W70-02946

**REINFORCEMENT YIELD CONDITIONS OF A REINFORCED CONCRETE MEDIUM WITH CRACKS,**
N. I. Karpenko.
Stroit Mekh Raschet Sooruzhenii, No 2, p 24-26, Mar and Apr 1968. Transl from Russ, Bur Reclam Transl 743, Oct 1969. 10 p, 1 fig, 5 ref.

Descriptors: *Reinforced concrete, *Slabs, *Reinforcement, Structural engineering, Yield point, Yield strength, *Cracks, Equations, Strength, Elastic theory, Theory, Foreign design practices, Normal stress, Bending moments, Moments, Stress, Tensile stress, *Mathematical analysis, Stress analysis, Shear stress, Two-dimensional, Three-dimensional.
Identifiers: *Concrete slabs, Yield line theory, USSR, Compressive stress, *Yielding.

Yield line analysis is used to develop equations for reinforcement yield conditions in a slab. Concrete and reinforcement will carry the load in areas where cracks do not intersect; concrete is excluded from carrying any load at points where 2 or more yield cracks intersect. Equations are developed for each case. Limits for application of the equation are set. Elastic analysis is used to develop the conditions of strength and a characteristic equation for a 2-dimensional stressed state, and to develop the yield conditions for reinforcement in 3 mutually perpendicular directions. (USBR)
W70-02950

**THE APPLICATION OF SPRAYED CONCRETE AND SURFACE CEMENTATION FOR ANCHORING THE ROCK FOUNDATION OF THE SHORE ABUTMENTS ON THE ASWAN HIGH DAM,**
V. I. Savin.
Hydrotech Constr, No 11, p 984-990, Nov 1968. 7 p, 7 fig, 3 tab.

Descriptors: *Abutments, *Grouting, *Rock foundations, *Dam construction, *Gunite, Concretes, Concrete mixes, Concrete placing, Concrete construction, Earth dams, Cutoffs, Trenches, Grout curtains, Foreign construction, Excavation, Dam foundations.
Identifiers: *Sprayed concrete, *Surface treatment, Concrete linings, Grout mixes, Aswan Dam (UAR).

Shore abutments for the core and upstream apron of the Aswan High Dam are trenches cut down to solid rock. The sides of the excavation have a 5:1 slope. Rock surfaces were covered with sprayed concrete 10 cm thick over the contact area between the rock and clay core. The purposes of the sprayed concrete cover are to: (1) form a base for the surface cementation, (2) prevent grout emerging from the rock surface, (3) provide a facing for the rock surface to prevent entrainment of clay particles along the rock/clay contact in the event of seepage, (4) set up a joining surface between the clay core and foundation, and (5) preserve the rock against erosion. Surface cementation was applied by grouting to a depth of 3 m. Deep grouting of the rock was performed along the axis of the dam and along the contour of the upstream apron shore abutments. The concrete spraying and grouting operations are described. (USBR)
W70-02958

## 8G. Materials

**GENERALIZED VARIATIONAL PRINCIPLES IN THE FINITE-ELEMENT METHOD,**
Boeing Co., Seattle, Wash.; and Vermont Univ., Burlington.
B. E. Greene, R. E. Jones, and R. W. McLay.
Amer Inst Aeronautic Astronaut J, Vol 7, No 7, p 1254-1260, July 1969. 7 p, 9 fig, 12 ref, append.

Descriptors: *Plates, *Shell structures, *Structural analysis, Deformation, Bending, Theory, Theoretical analysis, Displacements, Mathematical analysis, Deflection, Structural engineering, Finite differences, Stiffness.
Identifiers: *Finite element method, Static behavior, Matrix methods (Structural), Dynamic response.

In many situations, using pure oxygen offers an economically competitive alternative for artificial aeration of rivers and impoundments. Proper design of the oxygen injection system can make using pure oxygen very advantageous and achieve efficient absorption. The judicious selection of an oxygen injection system can result in side benefits and flexibility not possible when using air. The application of pure oxygen is economically competitive with air when attempting to aerate water that is about 50% saturated with dissolved oxygen or when attempting to achieve near-saturation concentrations in the effluent. Nitrogen concentration can present a serious problem when fish are involved, but can be alleviated by using pure oxygen. (USBR)
W70-02954

**OPERATIONS AND PERFORMANCE OF NEW DISTANCE MEASURING INSTRUMENTS,**
Environmental Science Services Administration, Rockville, Md.
Raymond W. Tomlinson.
Prepr 985, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 12 p, 1 fig, 1 tab.

Descriptors: *Surveying instruments, *Tellurometers, *Measuring instruments, Surveys, Measurement, Operations, Distance, Performance, Equipment, Testing.
Identifiers: Accuracy, Procedures.

Results are given of tests conducted by the US Coast and Geodetic Survey on the Wild Distomat DI-10 and the Tellurometer MA 100 distance measuring instruments, designed for precision on short distances. Both were easily operated by one person and the performance was very good. Persons with experience in operating microwave and electro-optical instruments need less than one-half day of instructions to obtain accurate measurements. Persons without field experience on this type of equipment should be given a 2- or 3-day training course under field conditions to become proficient operators. Because of the ease of operation and low price of a system, use of the instruments will result in better accuracy, increased production, and lower cost per mile of traverse projects. All field tests conducted for the DI-10 and MA 100 indicate that operation and performance will give accuracies of 1/50,000 or better within the claimed range. Results of measuring the same taped distances with each instrument are given. (USBR)
W70-02956

## 8I. Fisheries Engineering

**FISH HATCHERIES AND FISH PROPAGATION.**
For primary bibliographic entry see Field 06E.
W70-03194

# 09. MANPOWER, GRANTS AND FACILITIES

## 9A. Education (Extramural)

**EDUCATION IN HYDROLOGY, UNITED STATES UNIVERSITIES-EARLY 1966.**
Universities Council on Water Resources, Austin, Tex.

Texas Univ Report of Universities Council on Water Resources (UCOWR), July 1967. 44 p, 17 fig, 11 tab, 7 ref, 4 append. NSF Grant GE-7013 to Calif Univ, Los Angeles.

Descriptors: *Education, *Universities, *Hydrology, *United States, Engineering education, Training, Schools (Education), Surveys, Colleges.
Identifiers: Hydrology education.

At the institution surveyed, 859 faculty members reported some involvement with Hydrology education or research. The number of faculty members per institution varied from 1 to 42, with the median number being 8. Over half (52%) of the faculty have a background in Engineering, 22% in Biological Sciences, 20% in Earth Sciences and 6% in Other Fields. On the average, about 1/3 of faculty time is devoted to teaching, over 1/3 to research, and about 1/5 to public service or extension. Current effort occurs chiefly in Engineering, exceeding the combined effort in Earth Sciences and Biological Sciences departments. Most institutions offered courses with Hydrology content in several departments. Engineering departments offered more semester hours of Hydrology than the sum for the Earth Sciences and Biological Sciences departments. Civil Engineering departments account for about 306 students, while Forestry, Geology, Botony, Agricultural Engineering and Meteorology account for the remainder of a total of 340 students. In general, it is clear that the amount of student financial support available is low in those departments which produce the largest number of graduate degrees emphasizing Hydrology; these are Civil Engineering, Forestry, Geology, Botony, Agricultural Engineering, and Meteorology. (Knapp-USGS)
W70-02894

## 9C. Research Facilities

**SUPPLY OF AND DEMAND FOR TRAINED WATER RESOURCES PERSONNEL: A PILOT STUDY, Parts 1 and 2,**
Surveys and Research Corp., Washington, D.C.
Jacob Fisher.

Both parts available from the Clearinghouse as PB-189 045 (Pt 1) + PB-189 046 (Pt 2). $3.00 in paper copy, or $0.65 in microfiche. Report, Surveys and Research Corporation, Dec 31, 1969. Part 1, 189 p; Part 2, tables and append. OWRR Project C-1414.

Descriptors: *Manpower, *Labor supply, Occupations, Professional personnel, *Scientific personnel, Universities, *Training.
Identifiers: *Position characteristics, Position responsibility level, Position functions, Position requirements, Personnel demnd (Vacancies), Manpower demand forecasts, University faculty discipline identification.

The study was undertaken to test a methodology for obtaining measures of the supply of and demand for trained water resources personnel. The report presents the findings of three research projects: (1) a mail survey of 127 employing organizations selected to be illustrative of establishments employing trained water resources personneli in State and local governments, regional agencies, industry, engineering services, and non-profit organizations; (2) a mail survey of 17 universities with water resources institutes or engaged in teaching and research in water resources; and (3) a study of the employment of trained water resources personnel in the Federal government, based on interviews, correspondence, and examination of selected records. In the opinion of the survey staff, the methodological test successfully demonstrated the feasibility of a full-scale study of the subject. Recommendations are made on the scope and character of such a study, including sample size and data to be obtained.
W70-03038

# 10. SCIENTIFIC AND TECHNICAL INFORMATION

**SOME ASPECTS OF THE SCIENTIFIC COMMUNICATION SYSTEM IN HYDROLOGY,**
Department of Energy, Mines, and Resources (Ontario).
P. Meyboom.
Groundwater, Vol 7, No 4, p 28-37, July-Aug 1969. 10 p, 3 fig, 7 tab, 18 ref.

Descriptors: *Hydrology, *Publications, *Documentation, *Reviews, *Technical writings, Editing, Half life, Information retrieval, Bibliographies, Hydrogeology, Professional personnel, Technical societies, Data transmission systems, Communication, Professional societies, Data transmission.
Identifiers: *Communication systems, *Periodicals, *Information science, Professional advancement.

The scientific communication system is defined as the sum of all publications, facilities, occasions, and institutional arrangements permitting the direct or indirect transmission of messages among scientists. The system is considered according to 3 aspects: forulating, disseminating, and obtaining the message. A review of the extensive literature written about scientific communication is given. Ever since Bernal proposed to abolish all scientific periodicals, scientists have been concerned with ways and means of better communication. And yet, in spite of the profound improvements in technology, the average scientist is as archaic as ever in his communication. The purpose of this report is to inform hydrologists of the aspects of the scientific communication system that may be relevant to their work. Discussed are general concepts in scientific communication, characteristics of some well-known journals, and ways in which messages are obtained. Sex recommendations for making the best use of the scientific communication system are included, the most important being a rationale for restrained publication. (USBR)
W70-02952

**A PRELIMINARY BIBLIOGRAPHY ON EXTENT AND CAUSES OF EARLY MORTALITY**

**IN FRESHWATER FISH (DIADROMOUS FISHES EXCLUDED),**
Utah State Univ., Logan. Utah Cooperative Fishery Unit.
For primary bibliographic entry see Field 05C.
W70-02966

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| **A. Centers of Competence** | | |
| U.S. Geological Survey - Hydrology | W70-02843 -- 02894<br>03063 -- 03136 | 122 |
| University of Florida - Eastern U.S. Water Law | W70-02895 -- 02939<br>03177 -- 03218<br>02859, 02871,<br>02942, 02944,<br>02945, 02961,<br>02991, 03005,<br>03025, 03087,<br>03092, 03219,<br>03220, 03224 | 101 |
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